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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

May Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, April 29, 1899.

The May meeting of the Society of Gas Lighting will be held in "The Arena," No. 39 West 31st street, New York city, at 3 P.M., the 11th prox. FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION, OFFICE OF THE SECRETARY, NEW ALBANY, IND., Januarp 16, 1899.

To the Members of the Western Gas Association:

Mr. E. H. Jenkins, Editor of the Wrinkle Department, desires it known that those who have contributions to offer for publication in this valuable division of the Association's proceedings, should forward the same at as early a date as possible. Let no member fail to mail Mr. Jenkins a description of any device that saves labor or insures through its use better service in the production or distribution of gas.

Address all communications to Mr. E. H. Jenkins, Engineer Buffalo City Gas Company, Buffalo, N. Y. J. W. DUNBAR, Secretary.

BRIEFLY TOLD.

TO DEFINE THE POSITION OF THE KENTUCKY HEATING COMPANY.—Legal proceedings of a nature well qualified to enlist the attention of the fraternity have been instituted in Louisville, Ky., the complainant being the Louisville Gas Company, which corporation insists that the Kentucky Heating Company, in its supply of either natural or artificial gas for illuminating use to the residents of Louisville, is violating its promise to the State under its charter, and infringing the rights of the complainant as well. The Kentucky Heating Company, as the assignee of the right of the Kentucky Rock Gas Company to do business in Louisville, operates under an ordinance issued to the former by the General Council of the city, August 11, 1888; and the moving part of that ordinance, so far as our current comment on the matter is concerned, seems to be this: The Kentucky Rock Gas Company—the original purpose of which was to utilize for fuel or other use whatever natural gas might be found in the State, at any point in the State, provided the consent of the varying local authorities could be obtained—"is hereby granted the right and privilege and authority to lay down its pipes and mains in and along the streets, alleys and public ways of the city of Louisville, and make such other connections and arrangements as may be needful and necessary for the supplying of *natural gas* to the citizens of said city, for *heating purposes only*, for a period of 20 years from the date of the passage of this ordinance." The remainder of the ordinance relates to direction as to how, where and when the Company shall go on with the placing of its mains, the beginning of construction work, etc. The italics in the quotation from the ordinance are ours. The charter and ordinance under which the business of the Louisville Gas Company is carried on (the same date from January 1, 1889, and are to live for a period of 30 years) specify, among other things, that the Company is to have the *exclusive right* to manufacture and supply in the city illuminating gas for illuminating

and heating purposes. The Kentucky Heating Company established a main system and other necessary plant for the distribution of natural gas in Louisville and succeeded in gradually acquiring a very fair trade. In course of time the supply of natural gas, particularly in the winter season, shrank so perceptibly that the proprietors of the concern determined to resort to the manufacture, on their premises in Louisville, of an artificial, non-illuminating water gas, so that their supply might be kept up. The methods of its manufacture differed not perceptibly from those in common or accepted use elsewhere, which would seem to constitute a radical departure from the terms of their permission, which directs that natural gas *only* may be supplied. In any event, not content with supplying the mixed stuff on heating account, they permitted their customers to use it for illuminating account, with the aid of the Welsbach burner, and charged for such account and use a higher price than that charged when the stuff was used solely as fuel. The Louisville Gas Company waited to bring this contention for a period longer than ordinary commercial prudence would seem to permit, but now that its proprietors are in it for a decision the progress of the case will be watched with interest. The complainant claims that the answer to the question, as to what constitutes illuminating gas, is any gas artificially produced that is capable of developing illumination of any sort or by any device; and while we coincide in that view, we also believe that the ordinance (under which the assignee or successor of the Kentucky Rock Gas Company is operating in Louisville), directing it to confine itself to the distribution of natural gas for heating purposes *only* will be the greatest service to the Louisville Gas Company in its just contention. The language of the grant is plain. The Kentucky Rock Gas Company may distribute natural gas, and that distribution shall be only on heating account; and it certainly would be a greater wizard than Mr. Donald McDonald who could successfully substitute the artificial for the natural, as far as gas making is concerned. The initial hearing in the case will be before the Chancery Court.

NOTES.—Mr. Henry H. Hyde has removed permanently to Menominee, Mich., so that he may devote all of his time to the executive management of the Menominee Gas Light and Fuel Company. The business of the named Company is going ahead at a surprisingly rapid rate.——The transfer of the shares in the Gas Light Company of the City of New Brunswick, N. J., will be completed within a fortnight. We understand that over three-fourths of the shares have assented to the exchange. The National Bank of New Jersey is acting as the clearing house agent.——A correspondent incloses the following: "The annual meeting of the Norwich (Conn.) Gas and Electric Company was held April 22d. The officers elected were: Directors, E. N. Gibbs, H. H. Osgood, F. F. Brown, A. M. Young, G. E. Terry, M. F. Tyler and Garrett A. Hobart—Mr. Brown fills the vacancy in the Board caused by the death of Mr. Wm. C. Mowry—President, E. N. Gibbs; Treasurer, Morris F. Tyler; Secretary, A. M. Young; General Manager, Samuel Hurlbut. The Board decided to reduce the selling rate to $1.75 cubic feet gross, with a discount for prompt payment of 5 per cent. on all bills less than $10 per month, the discount to be 12½ per cent. on all bills in excess of that sum. It was further determined that no charge should be made for connecting up street mains and house services. The concession in selling rates affects all bills rendered July 1st."——Thos. A. Dunn and others are said to be backing a project for the construction of an opposition gas works at Atlantic City, N. J. Dunn and the others say they will furnish gas to the famous watering place for $1 per 1,000. Perhaps!——A combination known as the Cincinnati (O.) Natural Gas and Illuminating Company proposes to supply natural gas in that city, the source of their product to be the Sugar Grove field near Lancaster. It is said that the Company proposes, in case the supply of natural gas fails, to take up the manufacture of artificial gas. The officers of the concern are: President, Robert Laidlaw; Vice-President, E. C. Goshorn; Treasurer, George Bullock; Secretary, Jas. J. Hooker; Attorney, Senator Foraker. Meanwhile it is well to remember that General Hickenlooper is still in the gas business in Cincinnati; and Senator Foraker should remember the days of old.——The residents of Marshall, Mo., are besieging the local authorities to abandon the system in vogue there of lighting the streets by means of incandescent electric lamps.——Mrs. Rorer completed last month a most successful series of 10 demonstration lectures on cooking by gas, for the Pawtucket (R. I.) Gas Company. The lectures were delivered in the Music Hall Building, and Manager McGregor is to be complimented on the cleverness with which the work was done. The attendance at the "demonstrations" was notable for its numbers and representativeness.——We understand that the proposed gas plant for Newark, N.Y., will be constructed this summer.

Liquid Air as a New Source of Power: Another Engineering Fallacy.

[By PRESIDENT HENRY MORTON, Ph.D., LL.D., Sc.D., in Stevens Institute *Indicator*.]

During 1894–5 the present writer prepared two articles under the title of "Engineering Fallacies" which were published in this Journal, Vol. XL., pp. 273–294, and Vol. XII., p. 125.

Since that time, though several new forms of what might be termed in a general way "Perpetual Motion Schemes" have appeared, none of them has seemed of sufficient importance to warrant any special notice, but in the March number of *M'Clure's Magazine* there is published an article entitled "Liquid Air—a new substance that promises to do the work of coal and ice and gunpowder, at next to no cost," which is so eminently calculated to mislead the general reader and even to become the basis of financial frauds, like that of the Keely motor, that it would seem a duty to draw attention to the fundamental errors in scientific principles and in statement of facts which this article contains.

This *McClure* article may be fairly considered as made up of two prominent elements or parts, one of which is the statement of certain things as facts which, as I shall presently show, cannot possibly exist and are inconsistent with other facts stated in the same article and known from other sources to exist as so stated; while the other main element consists of rather vague statements concerning general principles which, though in a general sense true, yet as here used are calculated to cover up or befog the too obvious inconsistencies of the statements of facts, with the established principles of science.

As an example of the first element, we find on p. 400 as follows: "I have actually made about 10 gallons of liquid air in my liquefier by the use of 3 gallons in my engine." This I shall presently show is simply impossible and inconsistent with data given elsewhere in this article and known to be substantially correct.

A sample of the other element is found on p. 399 in the following: "That is perpetual motion you object. 'No,' says Mr. Tripler sharply; 'no perpetual motion about it. The heat of the atmosphere is boiling the liquid air in my engine and producing power exactly as the heat of coal boils water and drives off steam. I simply use another form of heat. I get my power from the heat of the sun; so does every other producer of power.'"

This, while true as a general statement of what might be done on an impractical scale, is not correct as here used to imply that in his experiments Mr. Tripler actually derives or can derive any adequate amount of energy from the heat of the atmosphere or in that sense directly from the sun. This I shall show later, but will first take up the statement that 3 gallons of liquid air have supplied or can supply the power to liquefy 10 gallons.

On pp. 402 and 403 of the *McClure* article we are told that Mr. Tripler uses to make his liquid air a steam engine of 50-horse power, and that with this he can make liquid air at the rate of 50 gallons a day. This I know from other sources is substantially correct, and means that *each horse power in a day (say 10 hours) makes one gallon of liquid air*. In other words, 1 gallon for 10-horse power hours.

It is again stated in this article on p. 405 that a cubic foot of liquid air contains 800 cubic feet of air at ordinary atmospheric temperature and pressure, or in other words, any volume of liquid air, if adequately heated, will expand 800 times in reaching atmospheric temperature and pressure. This also is substantially correct. We may remark in passing that this is nothing wonderful, for water when expanded into steam at atmospheric pressure increases about 1,700 times in volume, or more than twice as much liquid air. If we apply to the above data the well known and universally accepted formula for the maximum work done by air when expanded at constant temperature.

$$W = p_1 v_1 \operatorname{hyp\,log} \frac{v_2}{v_1}$$

We find that a pound of liquid air in expanding 800 times would develop about 190,000 foot pounds of work. As a gallon of liquid air weighs about 8 pounds, this would give eight times as many foot pounds, or 1,520,000. If this work were accomplished in an hour it would represent almost exactly ¾ of a horse power, because 1 horse power means 1,980,000 foot pounds of work per hour, and 1,520,000 is only a trifle over three-quarters of this. From the above it follows as a matter of *absolute certainty* that the maximum power which liquid air could develop in an *ideally perfect engine* without any loss from friction or other cause would be ¾ *of a horse power for an hour for each gallon of liquid air expended.*

We have seen, however, that with his 50 horse power plant, which on

account of its size should operate with considerable efficiency, Mr. Tripler *makes only* 1 *gallon* of liquid air with 10-*horse power hours*. In other words, he requires to make a gallon of liquid air 12 *times as much power* as a gallon of liquid air could *possibly develop* in an *ideally perfect* engine.

In face of this how supremely absurb is the statement that with a little engine such as the pictures and descriptions in the *McClure* article show, lacking all conditions for efficient working, Mr. Tripler can make 10 gallons of liquid air by the use of three.

Turning next to the statement about using the heat of the atmosphere to develop mechanical energy or work, let us put this to the test of a quantitative example.

Assume the temperature of Mr. Tripler's laboratory to be 70° F., and that he has an abundant supply of water at 50° F. These will be of necessity the limits of work he can get out of the atmosphere, because any lower temperature is only secured by doing work and so expending energy which will be at least equal to the power obtainable from the use of such lower temperature. All the work that can be obtained *for nothing* is that which nature will freely give in the warm air and cool water, supposing both to be supplied freely without charge.

The 20° F. which we may assume as being possibly taken out of the air by the cool water will represent the maximum gift of nature in this shape of "power costing nothing." Now 42 British thermal units, or pounds of water changed 1° F. per minute, will represent 1 horse power, and as the specific heat of air is about one quarter that of water, we would need four times as many pounds of air to produce the same effect. This would call for 168 pounds of air changed 1° F. If, however, the air is changed 10° F. in place of 1° F., we need but $\frac{1}{20}$ or 8.4 pounds of air parting with 20° F. each minute, to give us 1-horse power at 70° F. For "round numbers" let us say 8 pounds. Now a pound of air has a volume of about 13.3 cubic feet. Call this also "for round numbers" 13 cubic feet, then 8 pounds of air would be about 104 cubic feet, and this volume of air would have to part with its 20° F. heat each minute to the apparatus, in order to develop 1-horse power. For a 50-horse power engine 50 times as much air would be required, or 5,200 cubic feet each minute; this would be the contents of a room 26 × 20 feet on the floor and 10 feet high which would have to be drawn through the apparatus each minute in such a way as to completely yield its 20° F. between 70° F. and 50° F. What sort of a boiler or heat absorbing apparatus can we imagine which would absorb from air, at 70° F., 20° F. of its temperature while the said air was passing through it at the rate of 5,200 cubic feet a minute? It would surely need to be "as big as a house," to use a familiar phrase.

This also, be it remembered, makes no allowance for loss by friction, eddy currents, and the like, which would be enormous, nor for the power to put this air in motion.

Obviously such a machine would be simply huge in size, and indeed the friction involved in it would probably use up a large part of the power it could develop.

Suppose, however, that it could be built and operated in place of Mr. Tripler's 50 horse power steam plant. Its entire output would be 50 gallons of liquid air a day, and this, as we have seen, could only develop in an ideally perfect engine ¾-horse power for an hour for each gallon, or 3¾-*horse power for a day of* 10 *hours*. This does not look as if heat obtained from the atmosphere and operating an engine by aid of liquid air was likely to become a dangerous rival to the coal mine.

On p. 402 of the *McClure* article it is stated that Mr. Tripler makes his liquid air at a cost of 20 cents a gallon.

We have shown above that the maximum power obtainable from this liquid air, by heating it to ordinary atmospheric temperature, is ¾ of a horse power hour. This at 20 cents would be vastly more expensive than power derived from an ordinary steam engine, whose cost ranges from less than 1 cent per horse power hour under the best conditions to 3 or 4 cents, where a profit is included, or the conditions are less favorable.

The really difficult thing to explain in connection with this *McClure* article on Mr. Tripler and his liquid air, is how those concerned in its publication (being as I do not doubt honest men) can be deceived or have so deceived themselves as to make and repeat such obviously impossible statements. In this connection, however, I will make a suggestion founded on experience.

Some years ago I was called upon to examine an engine operated with liquid carbonic acid, which was said to have 10 times the efficiency of an ordinary steam engine.

I of course told the applicant that such a thing was physically impossible and did not deserve investigation, but finding that a number of substantial people had been so impressed by what had been shown them that they would not be satisfied without an investigation, I consented to make one. This proved an easy piece of work. I found that the promoters and others were under the impression that a horse power was measured by the raising of 33,000 pounds 1 foot high, *irrespective of time*, and in their demonstrations were contented with showing that their engine did this amount of work in 10 *minutes*. As, however, a horse power involves the raising 33,000 pounds 1 foot high in *one* minute, it was obvious that the power shown by the carbonic acid engine, was $\frac{1}{10}$ of a horse power and not *one* horse power, as those exhibiting the engine claimed. This, of course, explained the situation. An engine developing $\frac{1}{10}$ of a horse power might easily require only $\frac{1}{10}$ as much fuel as an ordinary steam engine developing 1-horse power, without violating any of the established laws bearing on this subject. The curious thing was that such people as were concerned in this matter should have been misled on such a simple and elementary subject; but if they were, as I personally know, so misled, why may not Mr. Tripler and his friends be in a similar case?

I could give from my own personal experience many like examples, but have said enough for the present, to make it evident that what is claimed in this *McClure* article for liquid air as a new source of "power which costs nothing," is not founded on fact, but is probably the result of some oversight in observation or calculation not inconsistent with honesty of intention.

Municipal Ownership in Massachusetts.

[By Mr. M. J. Francisco, in *Elec. World and Engineer.*]

The recent report of the Board of Gas and Electric Light Commissioners of Massachusetts, discloses some very important facts regarding municipal ownership, and proves conclusively that the system is a failure in that State.

On the 79th page of this report the expenses of all the municipal plants in the State are given as $150,536.20, and the entire income or receipts of the same plants from every source was $88,181.59, thus leaving a balance of expenses over income of $62,354.61. On the 78th page the Commissioners state that the investment made to establish these plants was $1,164,267; 4 per cent. interest upon this amount is $46,570.68 and 5 per cent. depreciation on the same is $58,213.35. The average rate of taxes in towns where these plants are located is $17.38 per $1,000 as shown on page 78. At this rate, calling their taxable value at $823,279.58, as shown on page 81 (which is $340,987 less than their investment), the taxes would be $14,308.59, making a total of $181,447.23, as the annual cost of 1,208 arc lamps, or $150.20 per lamp.

On page 88 we find the number of arc and incandescent lamps furnished by these plants and the hours run. If we convert the incandescent lamps into their equivalent in arc lamps, we have 1,208 arc lights of 1,200-candle power burned only 6.8 hours per night and 23.14 nights per month. The same report shows the business of private companies, and we find that taking the same number of private plants furnishing street lights in Massachusetts by contract, the average price for a 1,200 candle power lamp, was $81.31 per year, burning 7.9 hours per night 27.7 nights per month. This gives over one hour per night longer service, and four nights more per month, and at a cost of a little over half what it cost the municipal plants to produce the same lights. In addition, the private companies paid $31,516.11 in taxes to the municipalities.

The figures in both cases are the official statements as made to and verified by the State Commissioners. The actual record of every municipal plant in Massachusetts is given, and taxpayers in other States who are confronted with municipal ownership might well investigate these official figures.

Another fact disclosed by this report is the increase of taxation entailed by municipal ownership. When its plant was established, the rate of taxation in Braintree was $17.60 per $1,000, and it is now $18.20. In Danvers it was $17.90 and now is $19.20. Similarly the increase in Marblehead was from $17.00 to $19.20; in Middleborough, from $16.66 to $22.10; and in Reading from $15.50 to $18—thus indicating a steady increase arising from municipal ownership.

As shown on page 78, the investment made for municipal plants was $1,164,267, while on page 81 is given the balance sheets, showing the total assets of all the municipal plants in the State to be only $823,279.58. If the taxpayers invested $1,164,267, as the Commissioners say they did, and now have property amounting to only $823,279.58 to show for this investment, where is the balance between the two items amounting to $340,987? Is this not a direct loss to the taxpayers of Massachusetts, caused by municipal ownership?

The expenses of these plants increase year by year, as shown by the

records. The Braintree station in 1897 burned 753 tons of coal, while in 1898 973 tons were burned and only three more lamps were in circuit during the latter year than had previously been used, though 220 tons more coal was consumed. Danvers added only 15 lamps during the year, while its station used 253 tons more of coal than it did the previous year and used the lights a less number of hours.

Wages, repairs on lines and lamps, salaries, office and law expenses, cost of globes and bad debts, all increased in 1898 over 1897, and in some cases the items are doubled.

A great deal is said about the outrage of private companies charging $1.25 per 1,000 for gas. There are two municipal gas plants in Massachusetts, at Middleborough and Wakefield. The first named charges $2.64 per 1,000 and the latter $1.76 per 1,000 for gas, while a private company in Haverhill furnishes it from $1.30 and one in Lawrence at $1.50 per 1,000.

The statement of advocates of municipal ownership that gas and electric lights can be furnished by the municipalities cheaper than is charged by private companies, is thus disproved by the actual experience of all the municipal plants in Massachusetts. It is claimed that New York can produce gas for 50 cents per 1,000. Why, then, could not Philadelphia do so, and why does it cost the municipal plants in Massachusetts from $1.76 to $2.64 per 1,000, as the report quoted from shows that it does.

If every State had a Gas and Electric Light Commission similar to that of Massachusetts, the real cost of electric lighting by municipalities would be shown, and the public could no longer be deceived by the wild statements made by the advocates of municipal ownership.

[Continued from page 609.]

Experiences with the Incandescent Gas Light.[1]

By Mr. Norton H. Humphrys, F.C.S.

A matter of frequent remark, in connection with the subject of educational establishments, is that the sharp boys receive more attention than the dull ones. So much importance is now attached to passing certain examinations that there is a tendency to think more of the securing of a large number of successful passes than of the individual advancement of every boy. Something of the same sort obtains in business. The "lines" that show a maximum return with a minimum amount of trouble are assiduously cultivated, and occupy the front place. But just as an apparently dull boy, by special attention to his peculiar temperament, can be trained to make a creditable show for the school, so there are certain lines of business, at first sight by no means promising, but which are capable, by special attention and care, of being developed into important branches. The one under consideration is of this class. As already remarked, it has not received general approbation in the profession. Yet those who have taken it up with energy and determination have every reason to be satisfied with the results already obtained. There are few who could claim to have foreseen, five years ago, the important position to be attained by this new method of lighting in our streets, public buildings, shops and dwelling houses.

The chief and most evident objection is the light and fragile nature of the hood or mantle, which must be preserved from strong blasts of wind, or from sudden jar or shock, and which therefore calls for considerable care in the matters of lighting, extinguishing, cleaning glasses and accessories, etc. But this is not everything. The consumer is led to think that all he has to do is to be careful about the mantle, and does not also understand that the burner itself requires a little attention. This is a trifling matter, but sufficient to make or mar the success of the appliance. The burner used is not a common batswing or fishtail, but an air, atmospheric or Bunsen burner, as it is styled at different times. Its principle is well known to most gas consumers, and to all who use gas for heating. It is a sort of gas injector, drawing in a certain proportion of air, and mixing it with the gas previous to combustion—in short, the usual form of burner adopted for utilizing the heating rather than the illuminating properties of coal gas. It is, however, a different thing from the rough-and ready style of burner used in gas fires, gas ovens and gas boiling rings, in which strength and simplicity are rightly regarded as more important than strict scientific accuracy. These are practical, and not laboratory appliances. An important feature of the incandescent gas light is that the burner should be scientifically constructed, to give a regularly shaped flame that should properly fit the mantle. There is more in this term "mantle" than appears at first sight. The inventor of it was probably a married man, who had accompanied his wife to the milliner's shop, and knew from experience how particular ladies are in the matter of a good fit. That the mantle should be a good fit to the shape of the flame is of equal importance, only in this case the figure must be altered to fit the mantle, instead of the mantle being made to fit the figure. A flame of fixed dimensions being required, the burner must be accurately made, with delicately proportioned air inlets, passages, etc.; and it must necessarily include small apertures of one sort or another. In all Bunsen burners, the air aspirated or drawn in, and which is passing continuously from the point of admission to that of ignition, so long as the burner is in use, is apt to carry foreign matters, dust, etc., which may lodge and remain in some part of the burner. These are easily displaced by the air spray apparatus, if used regularly at least once a week; but if allowed to remain longer, they may bake hard, forming a permanent obstruction that can only be removed by taking the burner to pieces. Obviously, a very small obstruction may exercise an effect on the shape of the flame that would be of no importance with the gas fire or other heating burner, but yet may have a very marked result on the practical efficiency of the mantle.

These matters, and especially the first named—the fragility of the mantle—appear to unduly impress some who as yet have had no experience with the system. Though apparently of a serious nature to the eyes of the uninitiated, they become very simple after a little practical experience; and it is surprising how soon an ordinary workman will learn to handle the mantles and to employ the air spray. A large number of gas users, especially gentlemen whose hobbies run in the direction of constructive or scientific pursuits, have already taken kindly to the system (having gradually educated themselves in the details just mentioned), and are employing it with satisfaction; and many others would do so if the whole thing could be clearly explained to them. But beyond these there is the large class who, for various reasons, desire to be saved as much trouble as possible. They want everything self-acting and ready made; and already the line of "labor saving" devices has been worked to a ridiculous degree. A cheap invention for taking a handkerchief out of one's pocket would probably sell by the thousand. These people talk about the "labor" of lighting an ordinary gas burner; and the question of using an air spray apparatus once a week to blow out the burner is regarded by them as a great drawback. The only means by which they can be induced to take to the incandescent gas light is an efficient maintenance system; and the only persons who can satisfactorily carry out such a system are those who sell the gas.

Let us be quite clear as to what is meant by this. We have not hit upon a new line for adding to the profits at the expense of the gasfitter. When gas companies took up the letting of gas stoves on hire there was a howl raised on behalf of the gasfitting trade; the grasping gas company were going to take away the gas stove trade. This cry was raised without regard to the fact that in many districts only a dozen stoves or so had been sold within ten years, and there was no trade to take. The profits of the hiring trade, such as they are, might be in the hands of the gasfitting interests in two towns out of three, if they had chosen to take them; for many gas undertakings did not hurry into this branch, and did not take it up till pressed by their customers to do so. When we propose that the gas company should take up the maintenance of incandescent gas lights, the same complaint will be made; and the "trade" will suppose that the gas company are entering into an unfair competition with them, and seeking to take away their means of living. Ironmongers have repeatedly said to me, "It is no use our trying to sell gas stoves when you supply them on hire;" and I know that they have not sold a total of half a dozen at any time. With regard to our maintenance scheme, there is yet time for the trade to adopt it. Very few gas undertakings have as yet moved in the matter, and they will not do so if others take it up in an active or efficient manner. My reason for saying that the gas companies are the ones to take it up is not because they will thus secure a profitable new line of business, but because the direct profits from it are not sufficient to induce private traders to do so. The gas companies have their position and their sales to look to, and should adopt the new scheme as a matter that will strengthen the one and improve the other, and not as a source of direct profit.

It must not, however, be a source of loss. The benefits arising from the introduction of a cooking stove (which means a permanent addition of perhaps 500 cubic feet of gas per week to the demand) are so marked as to warrant some little outlay or loss; and so we find that a liberal policy in the matter of fixing, and so on, is in general favor. But the consumption of gas by a Welsbach burner is so small as to leave no margin for any "liberality." A No. 2 new-pattern burner, used from dusk to midnight on every evening of the year, will con-

1. *Journal of Gas Lighting.*

sume something under 4,000 cubic feet of gas. The profit on this quantity would not go far towards free fixing or anything of that sort. The consumer will not be likely to regard with favor any terms leaving a large margin of profit for the Company. The Welsbach Company have recognized this point; and a few weeks ago they issued a circular advising gas companies to undertake maintenance at cheap rates, and to supply mantles at less than shop prices. There is no limit to the eccentricity of the Welsbach Company. Not long since they required a written undertaking that the mantles supplied by them should not be sold at less than retail price; and by way of encouraging gas companies to adopt a liberal policy, and to enter into advance contracts for the supply of mantles, the circular above named was followed at the distance of a fortnight by a second, announcing an all-round reduction of discounts or rise of prices. So the gas company must go carefully into the matter, with a view of arriving at the actual cost of the service rendered.

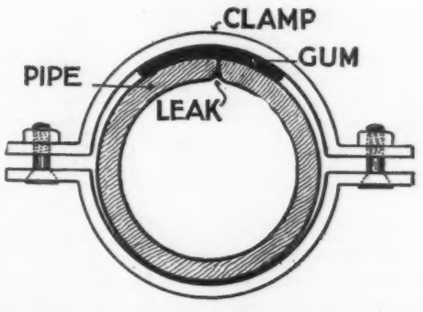
The maintenance scheme may or may not include hire or hire-purchase of burners and apparatus; and the charge made can be inclusive of mantles, chimneys, etc., or otherwise—the accessories being supplied at the shop rates, if the latter plan is selected. In the case of outside shop lights, places of worship and public rooms, the charge may include both lighting and extinguishing, according to an agreed schedule. I am not in favor of a fixed rate of so much per burner, because there is a great difference in circumstances, and no two cases come on all-fours with each other. In a place of worship, the consumption of mantles is so small as to be almost a negligible quantity; and the cost of cleaning glasses, etc., is also trifling, as there is a freedom from dust. The lights are used perhaps an average of six to eight hours per week; so that a mantle will last a year or more, and once a month will be quite often enough for a clean-up of chimneys and globes. Suppose there are 60 burners, a charge of 1s. per burner per quarter would mean £12 per annum, or more than twice the actual cost of service rendered. In a busy shop or factory, with plenty of dust and traffic, the consumption of mantles will average 6 to 8 per burner; and they must all be attended to at least once a week. A charge of £12 per annum would thus mean a loss of £8 or £10. The public will hear more about the enormous profits in the first case than of the loss experienced in the second; so the better course is to take out the cost of the actual service required in each instance, and put in an estimate based as nearly as possible on the actual outlay. In dealing with ordinary consumers, a small charge per quarter, sufficient to cover cost of inspection and cleaning only—the said inspection and cleaning to take place, not once a week or once a month, but as often as is necessary to keep the apparatus in an efficient state—is preferable to an inclusive charge. The consumer gets a direct interest in looking after the burners, as he knows he will benefit by carefulness, or suffer from carelessness. The majority will not figure upon the saving of gas that may be secured by the incandescent burner, but will regard the maintenance charge as an extra, like a meter or stove rent. One shilling per burner per quarter is a fair average charge to cover all expenses. But many consumers who have about 20 burners object to be tied down to a fixed charge of £1 per quarter, and think it extremely high, though they would pass an account for inspection and cleaning 5s., and mantles 15s., without any question.

The maintenance department requires so much and continual supervision that, except in very small concerns, it is too much for the manager to undertake in addition to his other duties. It should be placed under the control of a competent foreman or superintendent, capable of quoting prices to customers, of overlooking the staff of men employed, and of properly supervising working hours and materials used. He should also be able to deal with special cases. A place of worship, for example, lighted with ordinary flat flame burners, can be completely fitted up on hire-purchase terms to extend over seven years, under a guarantee that the total cost of gas, hire-purchase and maintenance shall not exceed the previous outlay for gas alone; thus affording a greatly improved light, with no initial outlay or increase in the annual charges. This offer is especially attractive if the fittings are old-fashioned, badly worn or otherwise objectionable, and at the same time the trustees are not in a position to entertain the expense of a complete renewal. The foreman should be capable of preparing an estimate of the cost of fittings and labor, cleaning glasses, etc., and renewals of mantles; so he must have an accurate knowledge of gas fittings and gas lighting generally. If such qualifications are not to be found in the existing staff of the company, the defect should be remedied as soon as possible. At Salisbury, we have been supplying (on inclusive hire purchase maintenance terms) outside shop lamps containing one, two or three burners each. These are kept in good order and lit at dusk every evening for a fixed charge per quarter; but extinguishing is not included, as the shopkeepers prefer a little license in this respect. Closing time may be at 8 o'clock; but the shop may be full of customers at that hour, and the sudden extinction of all the outside lights would quickly empty it. On the other hand, if things look quiet, and there is no prospect of business, the shopkeeper may like to put the lights out a quarter of an hour before time. It is, therefore, better to leave the extinguishing to the consumer. These are examples of special efforts to meet the requirements of customers, and as such represent the directions in which to work.

[To be Continued.]

Stopping a Leak.

Martin L. Kaiser, writing in the *Metal Worker*, says: A leak in a pipe is a small thing in the mind of many a customer, consequently he wants it stopped at once. As it is capable of making great trouble and doing serious damage it is often imperative that the little leak be stopped immediately. Every shop has customers of this kind, and unless some makeshift is ready to provide a temporary repair quickly, the customer may become unreasonable and it may be necessary to do a night job or interfere seriously with other important work. I have a method of stopping leaks in either iron or lead pipes, by using a strip of sheet



gum over the crack or hole, forcing it into the aperture, and holding it there by means of pipe clamps, which can be found in any shop or quickly made from heavy sheet iron. The application is readily understood from the sectional view herewith. Ordinary stove bolts will draw the clamps together, though round head bolts are better. This will stop the leak quickly, so that time can be had to make the permanent repairs needed.

About Gas Pipes.

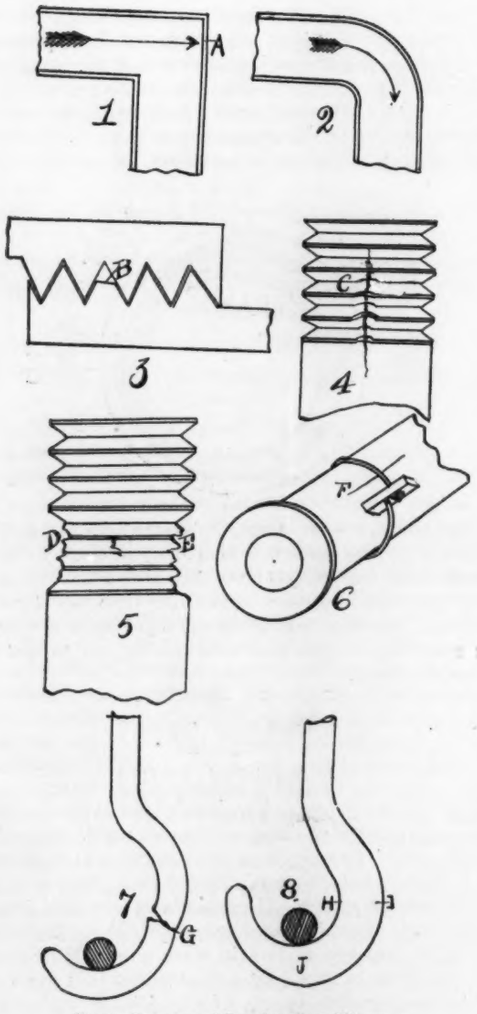
[Communicated by "R."]

Leaks in gas pipes are due to a number of mechanical defects in adjustment and plan, some of which will be described. In section drums which are connected by nipples to cross boxes or saddles, these cross boxes are manufactured either of flanged steel plates or of cast iron. Both of these are improper. If made of cast iron, it is impossible to have the curvature of the box conform exactly to the curvature of the drum, and when they are riveted in place one of three things must occur: (1), the sheets in the drums are distorted; (2), the cast iron is cracked from the pressure; or, (3), a leaky joint is made. The leaky joint is the most frequent result. When the inspectors find this they generally attempt to calk up the space with various metals, lead or Babbitt metal having been used in many cases, with the result that might be expected. After the connections had been tested the metal melts out and serious and irreparable leaks develop. Again, leaks may be due to the frictional wear of the gas on the interior of a sharp elbow. The force of the current of gas is received at *A* (Fig. 1), and in time the elbow is worn so thin at the point that a leak is developed. This difficulty is overcome by using round elbows, as in Fig. 2.

Defects in Threads on Gas Pipes.—Defective threading on gas pipes is of course a common cause for leakage of gas. At the same time much good piping is known to be discarded simply because of a slight defect in the thread which would not produce a leak. The general run of gasfitters will discard material on account of the threads being a trifle flat. If one will examine into the matter closely he will find that often the thread is defective only at one place, as at *B* (Fig. 3). Where it is flat no leakage will occur, for the reason that practically the entire thread on the pipe must be flat in order to conceive of a leak being produced, and then the leak must traverse the circumference of the pipe

as many times as there are threads in the contact. It is of course taken for granted that lead will be used on the threadwork of a joint. In the writer's experience it has not been so much that leakage in gas pipes was due to a few flat threads in connections as to poor fitting of threadwork; such for example as using threads which do not harmonize in the gauge.

Grooved Threads.—It is quite a delicate operation to class as perfect or imperfect pipes on which the threads are grooved. Small grooves sometimes occur in threads, due to the weld not being perfectly brought up. If the groove runs nearly the whole length of the thread work, as at *C* (Fig. 4), the pipe should be rejected; but if the groove extends only over a few threads, it will be seen seen upon a little reflection that this groove could not produce a leak unless it ran the entire length of the thread contact, and in depth went below the bottom of the thread.



Some Causes of Leaky Gas Pipes.

Broken Threads.—Another cause of rejection of pipe material is where the threads have been broken off a little; probably not as much as 1 per cent. of the whole bearing of the thread is gone, yet the fitter may see fit to reject the piece. A few broken threads in gas pipe connections need not necessarily affect the joint, unless the defects are of such nature that the mechanical action due to the movement in all fixed parts will increase the breakage. When the pipes come in contact with water the scaly incrustations which are developed will in time eat into the threads of the joint, at that portion which is unprotected, and destroy the threadwork completely, as at *D* and *E* (Fig. 5). Defects of the sort are far more dangerous than a few broken threads, for the reason that the incrustation increases with time and eventually the metal is so far gone that leakage occurs. The preventative for this corrosive action in the waters is afforded in various ways. Soda ash and other alkalies are very useful in waters containing sulphate of lime, by converting it into a carbonate, and so forming a soft scale easily cleaned. Petroleum has been much used of late years. It acts best in waters in which sulphate of lime predominates. As crude petroleum, however, sometimes helps in forming a very injurious crust the refined only should be used.

Milk of lime and metallic zinc have been used with success in waters charged with bicarbonate of lime, reducing the bicarbonate to the insoluble carbonate. Barium chloride and milk of lime are said to be used with good effect for waters impregnated with gypsum. Molasses, cane juice, vinegar, fruits, distillery slops, etc., have been used with success so far as scale is concerned, by reason of the acetic acid which they contain, but this is even more injurious to the iron than tannic acid, while the organic matter forms a scale with sulphate of lime when it is present.

Oak, hemlock, and other barks and woods, sumac, catechu, logwood, etc., are effective in waters containing carbonates of lime or magnesia by reason of their tannic acid, but are injurious to the iron, and not to be recommended.

As to the Valves.—Valves in the gas piping frequently leak through wear of the parts. If the stem pieces of the valves are badly scored have them turned off, the glands brushed and new neck rings made. With attention and proper fitting a great deal of future trouble can be avoided. If when moving the stem a gritting is heard, its results will be seen by creasing or scoring the rods. Leakage of valves in gas piping systems is indicative of waste and shiftlessness. Nine times out of ten grinding the seat of the valves effects a cure. A light grinding of the seat with a tool which is especially made for the purpose will not spoil any valve. A man may grind too much and so the seat is worn. Some men will almost grind a tool away before they get in working order. Just so in grinding valve seats. A few light touches accurately applied will do the work quickly and correctly. This will save many a valve from the junk pile.

Closing a Split in a Pipe.—It is sometimes necessary to clamp a cracked gas main during street operations; Fig. 6 shows a simple and quick method. A single rod of iron is cut with threads at each end, and, after wrapping it around the pipe over the crack *F*, nuts are provided for tightening the sides in the manner shown. Recently one of the mains in a plant sprung a leak. As it would not do to shut down a day to put in a new joint, we patched that old pipe with a clamping affair, which answered the purpose so well that we never removed it. We used a cup and plunger flange of an old friction pulley, filling the bowl with clay and red lead and squeezing the same together with bolts. Of course, the tighter we made the bolts the tighter we brought the clay upon the pipe, thus stopping the leak.

Gas Pipe Hooks.—Hooks for supporting pipe brackets should not be designed as in Fig. 7, for the reason that the strain falls chiefly upon the back of the hook, often resulting in breaking the back at *G*, as shown. Fig. 8 is a specimen of a more positive bracket hook, for in this form of hook the downward strain at *J* is supported firmly by the increased depth of the back at *H* and *I*. Hooks of the sort are reliable.

Rivet Work.—To make a strong seam in rivet work for gas apparatus we must use rather large rivets, spaced far apart, and put in several rows of them. In fact, the rivets should be placed as far apart as the plate will allow caulking to be done between the rivets without springing the plates. Putting the same diameter of rivets farther apart increases the plate section percentage, while increasing the pitch and diameter so that the spaces between the rivets remain the same, and has the effect of decreasing the plate section percentage, because the section remains the same while the width of the strip of plate is increased. Having found the right pitch and diameter for the rivets there now remains the laying of them out on the sheet. If we space the two rows evenly apart and put one row squarely behind the other we do not have the conditions of the greatest strength. To get this greatest strength we must "stagger" the rivets, so that the distance from one in a certain row to the next rivet in the next row will be equal to the pitch of the strongest single riveting. This may be figured as follows: The greatest strength of single riveting is when the plate section equals the rivet section. The latter area is 1.36 to obtain an equal plate area. The pitch must be $1.36 + 1\frac{5}{8}\ (1.3125) = 2.6725$, about $2\frac{3}{4}$ inches. This, then, would be the pitch for single riveting, and brings the rows within a trifle less than $2\frac{1}{4}$ inches of each other, and it will be seen that the intermediate rivet is able to strengthen the caulking edge of the plate a good deal.

Heller's Gas Burner.

On March 14th U. S. Letters Patent (No. 621,248) were granted to Mr. Adam Heller, of Baltimore, Md., for improvements in gas burners, which improvements relate "particularly to a portable burner

Fig. 1.

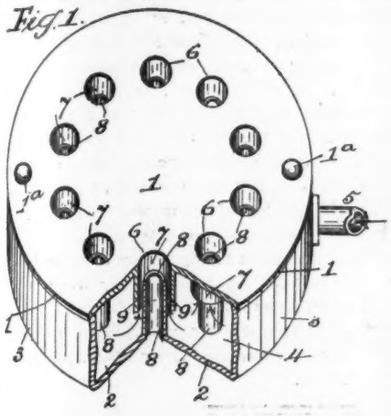


Fig. 2

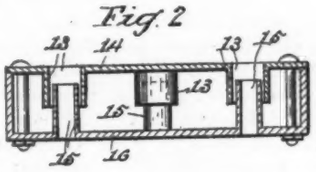


Fig. 4.

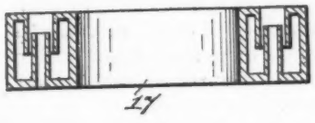
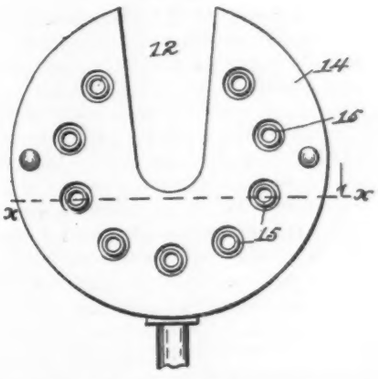


Fig. 3



adapted for domestic or other heating purposes." Using the words of the specification:

The prime object of the invention is to provide an improved gas burner of novel and peculiar construction and arrangement of parts to produce combustion upon the inside of the top of the gas chamber or within gas tubes depending from said top, so that each blaze given by such combustion will be solid or compact, without interruption in the body of the blaze as it comes from the top of the burner. This result is accomplished by any of the burners hereinafter disclosed. In all burners of this class now known by me the combustion takes place upon the outside of the top of the burner and is interrupted by a tube or pipe around which the blaze is formed, or combustion is made in air tubes having gas apertures and projecting above the top of the burner, or combustion takes place below the open top of the burner around an air tube extending above a gas tube, the mouth of the air tube interrupting or deflecting the blaze laterally. It is to overcome these objections and defects, and to produce a simplified improved burner having great heating capacity that my invention is intended.

In the accompanying drawings Figure 1 is a perspective view, partly in section. Fig. 2 is a section on the line x x, Fig. 3. Fig. 3 is a top view of a modification. Fig. 4 is a section of a further modification. The same numeral references denote the same parts throughout the several figures of the drawings.

The casing consists of a top 1, bottom 2, and sides 3, constructed and arranged together to form a gas chamber 4. As shown in the drawings, the said parts are secured together by bolts 1a, and the casing is circular, but it may be any desired form or shape, and provided with a gas inlet 5 to the chamber 4.

The top 1 has holes 6, from which depend into the chamber 4 open gas tubes 7, having a solid or non-perforated wall. These tubes are preferably cast or formed integral with the top 1, though they may be otherwise connected.

The bottom 2 has air tubes 8 in the chamber 4, which tubes project upward and terminate in the tubes 7, with an interval or space 9 between the tubes 7 and 8 for the passage of gas and the mingling of the latter with the air.

It is obvious that the gas passes from the chamber 4 into the space 9, meets the air from the tubes 8 in the tubes 7, where combustion takes place and when the blaze is emitted in a straight, solid, uninterrupted mass.

The form of burner shown in Figs. 2 and 3 is U-shaped, or has an opening 12 from its edge to the center of the burner. This burner has gas tubes 13 depending from its top 14 and upwardly projecting air tubes 15 from its bottom 16, which terminate in the tubes 13, the top tubes being larger than the bottom tubes for the purpose of forming the space hereinbefore referred to.

In the form of burner shown in Fig. 4 the same tubes are employed, the only difference being in the shape of the burner, which is all in one piece and has a central opening 17, making a ring-shaped burner.

I do not wish to be understood as limiting myself to any particular size, shape or material in the manufacture of the burner, nor to the purposes to which it may be applied.

The claims of the inventor are:

1. In a gas burner, the combination, with the casing forming a gas chamber, and having holes in its top and bottom, of the tubes depending from the top holes, and the tubes projecting from the bottom holes into the said depending tubes, to leave a gas passage or space from said chamber between the telescoping portion of the tubes.

2. The combination, with a casing forming a gas chamber, and having holes in its top and bottom, of the tubes depending from the top holes and terminating in the chamber above the bottom holes, and the tubes projecting from the bottom holes and terminating in the depending tubes so as to leave a gas passage from the chamber between the tubes, and a combustion space in the depending tubes.

3. The combination, with a casing forming a gas chamber, of the open tubes depending from the top of the casing and terminating in said chamber, and the open tubes projecting from the bottom of the casing and terminating in the said depending tubes, to leave a gas passage and a combustion space.

The Problem of Electrolysis.

Engineering Record, in editorial comment on "The Problem of Electrolysis," says:

It seems probable that within a few years the electric railway companies will be forced to meet a litigation similar in certain respects to the suits brought against them by telephone companies some ten years ago. It will doubtless be recalled by those familiar with the operation of street railways that, soon after the change from horses to electric traction was made, the patrons of telephone companies became more and more discommoded by imperfect service. The only message received over the wire was not infrequently a buzzing like that from a distant sawmill. It did not take the telephone companies very long to trace the trouble to the return circuits of the electric street railways. The currents wandered away from the tracks and caused the trouble on the telephone circuits, which were of the old-fashioned grounded type. Complaints became so numerous that the telephone companies were forced to adopt some remedy. They were compelled to put up all-wire circuits or the railway companies had to use insulated returns, keeping their electric currents on the legitimate path for them. Very naturally the telephone companies preferred to have the railway companies do the work. The railway companies just as naturally declined, and the result was the important litigation which finally determined that the telephone companies did not have a monopoly of all the earth and the fullness thereof. Since that time they have put up all wire circuits and also their prices, for they are not engaged in business from philanthropic motives.

It is not more than seven or eight years since the straggling currents from the electric railway were found destructive to a far more important branch of public service than telephones. People conducted business for many years without them, but a water supply has been essential to the well-being of communities for many decades. The situation of a city suddenly deprived of water for a protracted period is inconceivably serious. Power plants would be shut down from lack of water for the boilers, industries would largely come to a standstill, and the inconvenience of the people themselves during the first few days would soon become full of menace to the public health. Hence it is that any danger to a water system is far more important than a similar danger to a telephone system. There seems to be no doubt at the present time in the minds of some of the most conservative managers of waterworks that the responsibility of electric railway companies for the wandering currents from their tracks should be definitely settled in the highest courts. They point out that it is the height of folly to wait for a serious accident before applying the remedy which would have prevented it. It has been shown in these columns time and again that small pipes have been completely wrecked by electrolysis due to the return circuits of electric railways. That in itself is a sufficiently important situation to merit attention, but when it is considered that the

same action which destroyed these little services is also slowly ruining the large mains, it is evident that a careful study of the subject should be made.

There is really nothing mysterious about this corrosion of conduits by electric currents. The action is precisely the same as has been employed for many years by electroplaters. If two plates of metal are placed in a material which will conduct a current of electricity, and such a current is sent from one plate to the other, the plate from which the current flows will be gradually eaten away. It makes no difference whether the material is damp earth or the solution used in the vat of the electroplating apparatus. The only difference between the two cases is that in the former the corrosion is taking place several feet below the surface, out of sight and frequently out of mind, while in the latter case it is under the watchful supervision of a workman. Just so long as electric currents return to the power stations of street railways through the track, there will be danger to the water main. Thorough bonding of the rails, the use of large supplementary return wires and like precautions simply diminish the danger. It is one of the laws of electricity that where a current has two paths by which to reach a certain point, it will divide, part going by one path and part by the other, in direct ratio to their conducting capacity. In the case of a street railway separated by 6 feet or so of earth from a water main, the return current has two paths back to the power house. One of them is through the rails, the other is through the earth and the water main with the service pipe running from it into the power station. If the earth is dry and the track is well bonded, most of the current will return through the latter, but unless the accepted laws of electricity are false, some current will pass through the earth. In case the track is of the poorly bonded type, still to be seen in many places, then the proportion of current returning through the earth will be greater. The water pipes, being wholly of metal, are the best of conductors, and if they are in the earth in the vicinity of the track, the current makes for them. If these facts had been understood by city officials, there would not have been so many ridiculous ordinances passed concerning electrolysis. There seemed to be a mania some years ago for a type of ordinance specifying certain classes of bonding in the track, and then requiring all currents to be kept off the water mains, a requirement as absurd as a demand for the companies to make the sun stand still at noon. It was eminently proper to require the companies to send their return currents back to the power house through well bonded track circuits, for that practice diminishes the danger to the pipes, as before stated. To add to that requirement, however, a demand that no electricity should be allowed to escape from such a track system to the pipes was utterly absurd.

It has been shown by a number of engineers that the double trolley system is the only positive remedy for electrolysis. In that system, whether the wires are overhead, as in Cincinnati, or in conduits, as in several cities, the chances for any leakage of current to the ground are infinitesimal. The overhead double trolley is unsightly, and the network of wires is not regarded with favor by fire departments or insurance underwriters. The conduit system is expensive, too expensive for use in many localities. It is evident, therefore, that the problem becomes one of minimizing to the utmost the danger to which water mains are exposed by the present single trolley system of operation. Progressive railway managers have long recognized the fact that if a street car system is built for operation and not sale, it pays to make the return circuit of large conductivity. Some companies have found that a remodeling of their plants in this respect has been equivalent to a large increase in traffic, so great was the previous loss of power from the straying currents. It is hardly likely that enterprising companies will put any obstacles of moment in the way of city officials endeavoring to keep these wandering currents where they belong. Unfortunately, many street railways in this country were built for sale and not for operation. They are poor affairs at the best, and are run on such a small margin of profit that much aid cannot be expected from their managers. These are the companies which render electrolysis so serious, for they will fight every attempt on the part of the city officials to compel them to better their return circuits.

There has probably been no litigation which furnishes a precedent as to the final decision of the highest courts in a case similar to that of the destruction of water mains by railway return currents. In the telephone cases it was possible by the use of all-wire circuits to avoid the inconvenience caused by the railway currents in the earth. In case of the water works mains there is no such remedy. The pipes are there, and form, under certain conditions, a path along which some current is bound to go. It seems, in the light of present knowledge, that these currents may be so reduced by proper precautions as to be without danger in most cases. It is equally evident, however, that the distribution system of the city should be watched with great care to detect any signs of incipient electrolysis. Whether the cost of this inspection must be borne by the city or the railway companies is a question for the courts to decide. It is to be hoped, however, that the authorities of Dayton or some other city where the water mains are being seriously damaged will take the matter into the courts and determine once for all whether the wholesale destruction of a pipe system, which must eventually result in great expense and inconvenience to a large portion of the citizens, is to be permitted unchecked. Electric railways are certainly a great boon, and nothing should be done to restrict their construction and operation except for a greater public good. As a rule, however, they pay little or nothing for the right of using the streets, on which their existence practically depends, and it seems but just that they should be made wholly responsible, not only for the injury they have done to water works systems, but also for preventing further injury in the future.

Gas Exhausters and Gas Exhausting Plant.[1]

Last March Mr. R. Hargraves (Blackburn) read a paper on the subject named in the heading before the Manchester (England) Association of Engineers. The author, having referred to the object of the use of the exhauster, went on to say :

According to the Board of Trade returns of the gas authorities of the United Kingdom for the year 1897 coal was carbonized for that year to the amount of 12,616,513 tons, and the quantity of gas, therefore, works out at 252,461 cubic feet per minute for every minute of the year. The make of gas during winter exceeds the summer's make in the approximate ratio of 3 to 1, or, roughly, 380,000 and 126,000 cubic feet, respectively, per minute. The power required for pumping the maximum quantity against an average water pressure of say, 18 inches is not great. I estimate it at about 4,000 indicated horse power for the United Kingdom in winter, assuming, of course, that gas is being made and pumped night and day. The amount of power used in exhausting gas and forcing it into holders seems very inconsiderable from a mechanical engineer's standpoint, and of small commercial value, but the capital sunk in this department of the gas works of the United Kingdom cannot be far short of $1,000,000, and is increasing at the rate of about 5 per cent. per annum, notwithstanding the advent of electric light. Of course, $50,000 of new business every year is not a very large amount; but it is not to be despised, and it represents the requirements of the United Kingdom alone.

I believe the first gas exhauster on record is the one used by Broadmeadow in 1820. It was arranged with three bells working in water seals, and was actuated by a 3-throw crankshaft, the bells having suction and delivery flap valves inside. These, however, were displaced, in time, by the double acting reciprocating type, which are doing excellent duty in many gas works at the present time. At one time exhausting gas by means of a steam jet was in fairly extensive operation, and in a few works this system is still in use. It is said, however, that with large counter pressures these exhausters cannot be used with advantage, because (the consumption of steam increasing in exact proportion to the counter pressures) when 24 to 36 inches of water pressure is reached the consumption of steam becomes too great for economical working, and the liquor is weakened too much by the condensed steam. For small works this type of exhauster is practicable enough, and would be low in first cost.

Proceeding to briefly describe, with the assistance of drawings, the chief features of Beale's 1866 patent, Beale's 1877 patent, and the Beale-Donkin type of exhauster, which he said were perhaps in commonest use at the present time, Mr. Hargraves pointed out that in the last mentioned type the capacity of the exhauster was increased by compounding the reciprocating pump inside the axle with the rotary pump of Beale. With this arrangement the friction was very little increased, while the pumping capacity was increased by about 40 per cent. In illustration of this, the results were submitted of a series of experiments made in 1893 by Mr. J. W. Helps, of Croydon.

Pressure.—The pumping efficiency of these exhausters (the author went on to say) depends upon the pressure against which they have to work. For pumping water against a considerable pressure they would be unsuitable, but for pumping gas at low pressures they answer their purpose well, and especially so with a little tar oil lubricant forced in from time to time. A curve showing the slip when pumping gas is shown, Fig. 1.

1. *Gas World.*

This curve gives the percentage of slip for gas pressures varying from 1 inch to 60 inches of water. A leakage curve is shown in Fig. 2, giving the slip when pumping air against resistances of from 10 to 150

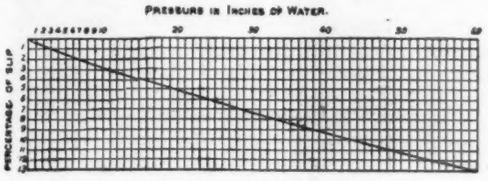


Fig. 1.

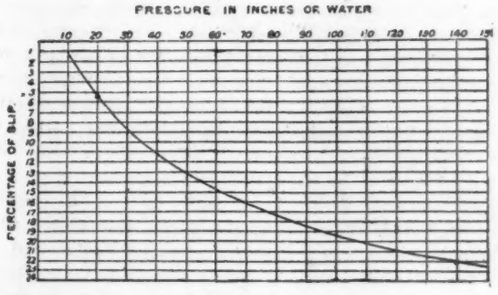


Fig. 2.

inches of water pressure. It was thought at one time that the Beale type of exhausters might be used with advantage for supplying blast furnaces with air blast. Could this have been accomplished, the ponderous blowing engines of our time would have had to give place to the rotary pump. A glance, however, at the curve, Fig. 2, will soon show that the slip is so great, against 150 inches only of water, that at pressures required for blast furnaces the efficiency would have been too low for economical working. A uniformly steady gas pressure is always a condition to be desired, as registered by either a mercurial or water gauge at the outlet of the exhauster. Perhaps all exhausters will give a fairly steady gauge, owing to the enormous volume in which the gas is forced by means of pumps either on the reciprocating or rotary class.

Uneconomical Steam Engines.—The engines usually adopted for driving exhausters are the plain, single slide valve cylinder engine, either horizontal or vertical. If the engine is required to be of a fair size, a Meyers' cut-off is sometimes applied in the ordinary manner. There is nothing special in these engines, save that they should be extra strong and well made, with extra provision for continuous lubrication, as they run night and day, Sundays included, for months together. Very little has yet been done in these engines to get a maximum of steam economy. They will certainly not compare in economy with modern engines driving mills, electric light stations, etc. Mr. Corbet Woodall stated, in a paper on gas exhausting, read before the British Association of Gas Managers in 1877, that he had found the feed water per indicated horse power per hour in engines driving gas exhausters to be as follows:

Non-condensing engines.....	76.25	pounds water per indicated H. P.
Beam condensing engines.....	56.00	" " " "
Compound condensing engines	25.80	" " " "

One would naturally suppose that great improvements would have been made since then, but these figures compare very closely with some results obtained a few years ago from a large gas exhausting plant near London, and I am not aware that better results than 20 pounds of steam per indicated horse power have been obtained anywhere. The improvements effected in recent years have been chiefly in exhausters themselves, and not in engines. The alterations have all been made to reduce frictional resistance, and to obtain more work out of the exhauster for practically the same power. It may be taken as fairly correct that 2 pounds of steam, with the latest types, will exhaust and force 1,000 cubic feet of gas per hour against a resistance of 24 inches of water.

The governing of exhauster engines is probably the only special feature about them. The object of an exhauster is to draw the gas out of the retorts, and to maintain therein a slight vacuum at as constant an average pressure as possible. The process of distillation is, however, more rapid at one time than another, when the engine should run faster, or more slowly if the make of gas be sluggish. The regulation of the speed of the engine in accordance with these conditions is different to that of an engine for ordinary mill driving. In the former case the object in view is to vary the revolutions according to make of gas, but in the latter case a uniformly steady speed is the idea of good turning. Therefore, for governing the speed of engines driving gas exhausters, a hydraulic regulator is usually made use of.

Mechanical Efficiencies.—The mechanical efficiencies of the Beale rotary gas exhausting plant depend upon the pressure of gas against which the pumps will have to work. In the series of experiments conducted by Mr. Helps, of Croydon, in 1893, with a total air pressure of about 8.8 inches of water the theoretical horse power of the air discharged was only about 26 per cent. of the total horse power of the plant, while with air pressures raised to 49 inches of water the corresponding horse power was as much as 58 per cent. of the total horse power. The relative mechanical efficiencies of the three types of exhausters already mentioned, in actual gas pumped against about 33 inches of water pressure, may be taken, approximately, to be as under:

Beale 1866 pattern.....	25 per cent.
" 1877 pattern.....	45 "
" Donkin pattern	55 "

These efficiencies, however, would only be approximately true for the three types of exhausters of equal capacity, and working against the same resistance, but for comparing one with another they may be taken as fairly correct. The power required for pumping gas may be ascertained from the usual formula, viz.: $\frac{W \times H}{33{,}000}$ = indicated horse power, where W = weight of gas, in pounds, pumped per minute, and H = head of a column of gas in feet which will balance the gauge pressure in inches of water.

The following table, for which I am indebted to Messrs. Bryan Donkin & Co., Limited, shows the theoretical horse power required to pump gas without any allowance for exhauster and engine friction. The table will be more useful to gas engineers than to mechanical engineers, as the powers are based upon exhausters passing various quantities, in cubic feet per hour, which is the most convenient form for gas engineers.

Table giving the Theoretical Horse Power Required to Pass Gas at Various Pressures, without any Allowance for Friction of Exhauster.

Cubic Feet per Hour.	6 In.	9 In.	12 In.	15 In.	18 In.	20 In.	24 In.	30 In.	36 In.	40 In.	50 In.
5,000	0.08	0.12	0.16	0.19	0.24	0 26	0.31	0.39	0.47	0.53	0.66
10,000	0.16	0.24	0.31	0.39	0.47	0.53	0.63	0.79	0.95	1.05	1.31
15,000	0.24	0.36	0.47	0.58	0.71	0.79	0.94	1.18	1.42	1.58	1.97
20,000	0.31	0.47	0.63	0.79	0.95	1.05	1.26	1.58	1.90	2.10	2.63
25,000	0.39	0.59	0.79	0.98	1.18	1.31	1.58	1.97	2.37	2.63	3.29
30,000	0.48	0.71	0.94	1.18	1.42	1.57	1.89	2.36	2.83	3.15	3.94
40,000	0.62	0.94	1.26	1.58	1.90	2.10	2.52	3.15	3.78	4.21	5.26
50,000	0.79	1.18	1.58	1.97	2.36	2.63	3.15	3.94	4.73	5.25	6.57
60,000	0.94	1.41	1.89	2.36	2.84	3.15	3.79	4.73	5.67	6.30	7.89
80,000	1.24	1.84	2.52	3.16	3.80	4.20	5.04	6.30	7.56	8.42	10.50
100,000	1.58	2.37	3.16	3.94	4.73	5.26	6.31	7.89	9.47	10.50	13.15
150,000	2.37	3.54	4.72	5.90	7.09	7.87	9.46	11.80	14.20	15.80	19.70
200,000	3.16	4.74	6.32	7.88	9.46	10.50	12.60	15.80	18.90	21.00	26.30
250,000	3.95	5.92	7.90	9.85	11.80	13.10	15.70	19.70	23.60	26.20	32.90
300,000	4.74	7.11	9.48	11.80	14.10	15.70	18.90	23.60	28.40	31.50	39.40

The Steam-Jet Exhauster.—It has already been stated that, at one time, exhausting gas by means of steam jets was in fairly extensive operation, and that for small works and low counter pressures it might even be used with advantage at the present time, on account of the low first cost of plant for exhausting gas on this principle. In this respect there is no comparison between this plant and plant of either the rotary or the reciprocating types, and if the former system could be made to move an equal weight of gas as economically as regards steam consumption, the steam jet exhauster would have a very great future; but, unfortunately, it has not (so far as I am aware) done so yet, and I doubt very much if it could be made to do so, notwithstanding its great simplicity. These exhausters may be fixed horizontally, vertically, or diagonally, and will work equally well in any of these positions. A steam trap should be placed in the most convenient position for drawing away the condensed steam from the pipes, and it is advisable to arrange the gas mains with a by-pass arrangement, in case the exhauster should go wrong.

As in all other types of exhausters, the consumption of steam is proportional to the quantity of gas exhausted and to the pressure against which the gas is forced. In exhausters of the steam jet type it has been found that the consumption of steam per 1,000 cubic feet per hour of gas, against a resistance of 24 inches of water is, approximately, about 10 pounds. This is five times greater than the best result obtained from a Beale 1877 rotary exhauster driven by a compound engine. These results are practically equal to about 100 pounds of water per indicated

horse power for steam jet exhausters, against 20 pounds of water evaporated per indicated horse power for the Beale exhauster. This type, therefore, is worse by 33⅓ per cent., as regards steam economy, than Mr. Corbet Woodall found in 1877 for exhausters worked with non-condensing engines. The steam jet plant is simple and cheap in first cost, but I am afraid it is applicable only when steam economy is not of first importance.

The Reciprocating Type.—I have been somewhat disappointed in not being able to obtain reliable data of the economical working of gas exhausters of the reciprocating type, and so cannot compare their working with the result of the two other types referred to in this paper. It is a pity, because I am of opinion that with a first-class plant the mechanical efficiency would be quite good enough, if not even better than that of the rotary type of exhauster, and also that the fluctuation of gauge would be quite good enough for gas exhausting purposes. Exhausters on this principle which I have seen working appear to be working well and giving the greatest satisfaction.

Nernst's Electric Light.

[A paper read by MR. JAMES SWINBURNE, before the Society of Arts, London.]

Before describing Nernst's invention, it may be profitable to spend a few minutes in reviewing the position of electric lighting. The whole industry is at present controlled by the incandescent lamp. We are so accustomed to this, and it is taken for granted in such an unconscious way, that we do not realize how much everything depends on the maker of the carbon incandescent lamp.

In very early days—that is to say, in the early eighties—there were a few Edison lamps at 100 volts, with an efficiency too horrible to mention; but the Swan lamp made for 50 volts came along. I say made for 50 volts advisedly; I mean that the makers tried to make 50-volt lamps, and produced lamps taking from 40 to 60 volts. If the lamps were not bright enough, you ran the engine faster, or put a smaller pulley on the dynamo. The belt then generally slipped; but that is not to the point. For about four years, which is a long period in the development of such a rapidly growing industry as electrical engineering, the makers of incandescent lamps—or, in fact, the makers of the Swan lamp—decreed that the electro-motive force used should be from 40 to 60 volts. There was no appeal. There was no development of central station supply at that time; but still, even then, in large buildings there was the longing for higher pressures, on account of the cost of the mains.

About 1885, the Swan 100-volt lamp came into use. It was a clumsy affair, with little loops of platinum at the sides. At first the lamps were pretty bad, but they gradually improved; and 100 volts, or in some cases 110 volts, became the recognized pressure for electrical supply. As town lighting from central stations came into being, the limit of 100 volts became a serious trouble, and the evil was partly mitigated by the use of 3 or even 5 wire systems.

I must point out that the incandescent lamp exercises its tyranny in two ways. It not only insists on a low pressure, such as, say, 100 volts, and thus demands large leads to feed it, but it is so sensitive to variations of pressure that the system of distribution has to be arranged to give a practically uniform pressure at the terminal of the lamp. The necessity for uniform pressure probably gives more trouble, and costs more than the mere low pressure; and it would be cheaper to supply at 100 volts with a good margin of permissible variation of pressure, than supply at 200 with a very small percentage of variation.

Quite lately the incandescent lamp makers have produced things called 200-volt lamps, and some make them for 250 volts. So there is a general tendency on the part of supply companies to jump to a 200-volt supply. The innocent consumer is therefore pressed by the company to change over to 200 volts. The company like the change very much; and the lamp maker enjoys it, as he makes more lamps, and charges more for them.

Considering the enormous importance of the incandescent lamp, its improvement has received extraordinarily little attention. It limits us as regards pressure; it used to hamper us by its cost; it limits us as to variation of pressure; and it limits us very seriously by its inefficiency. Yet, in spite of these, the carbon incandescent lamp has made practically no advance in fifteen years. Of course, mere detail improvement in manufacture has taken place, and this has led to better quality and greater uniformity; hence cheapness. But there has been no radical improvement. The jump from 100 to 200, or from 50 to 100 volts, did not depend on any sort of radical improvement in the incandescent lamp; it was merely the result of detail improvements, making it possible to produce long thin filaments. Other things being equal, it is easy to see that these filaments must be weaker. If the carbon has the same specific resistance, the relation between pressure and length is $E = L^{\frac{3}{2}}$ and $E = D^{-\frac{3}{2}}$. If the filaments are flashed, the proportions will be still more extreme.

The question of high pressure incandescent lamps is thus: How far can we make the filaments longer and thinner and flimsier without exasperating our consumers? Unfortunately the consumer is rapidly getting saddened as it is. The 100-volt 8 candle lamp does not please him much, and the 200-volt 8-candle lamp has in no way delighted him. If the lamp is made with two 100-volt filaments in series, it combines the disadvantages of both without the advantages of the small candle power of either. But it adds some further disadvantages peculiar to the higher pressure which I have not so far touched upon, and that is that the higher the pressure the more troubles there are through the silent discharge, or whatever it is called. I need only refer to the well-known experiment in which a third terminal is sealed into the lamp. A galvanometer then shows a current going across country inside the lamp. This is no doubt intimately connected with the life, or rather with the death of the lamp.

I have dealt at some length with the question of high pressure incandescent lamps because the subject is really of vital importance, and is too much neglected. Our technical colleges, our technical press, and our technical societies pay the greatest attention to the question of a per cent. or two in the efficiencies of dynamos and transformers, and give a good deal of attention to engines and boilers. That is because there is plenty of room for calculations in connection with these subjects. But the incandescent lamp, which at present holds the whole career of the lighting industry in the little curl of flimsy red hot carbon that can hardly support its own weight, receives no attention at all. How much does the average electrical engineer know about incandescent lamps? The only subject that is treated in the same way is the cable. About half the money in town lighting goes in the cable, a mere fraction in the dynamos and transformers themselves; so the average electrical engineer knows nothing about cables.

So far I have only discussed the incandescent lamp; the arc lamp has also to be considered. I will not say much about the arc lamp just now, but will add a little more when the Nernst lamp is compared with it. The ordinary arc is limited in pressure to about 50 volts, including the series resistances necessary for regulating. The inclosed arc is a new development which is more satisfactory as regards pressure and the consumption of carbon.

The lamp I shall describe to-night is the invention of Professor Walther Nernst, of the University of Göttingen. Though he is a young man, Professor Nernst's name is already known to all modern chemists as a leading authority and original thinker in the field of physical chemistry. It is unusual for a man who has climbed to the top of one tree to jump to the top of another.

Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on the temperature. The efficiency of an incandescent lamp, for instance, depends on temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature—especially as, in addition to its low specific resistance, the filament has to be long and slender, and thus weak. Nernst, therefore, chose a material that would stand higher temperatures than carbon; and his material has the incidental advantage that its specific resistance is so high that strong rods can be used for high pressures instead of thin filaments. The most refractory materials so far used in lighting are zirconia, which has been employed to replace lime in the limelight, and the oxides, or so-called rare earths, in the Welsbach mantles. I am aware, of course, that many people suppose that the Welsbach mantle is not very hot; treating it as if it were at a temperature, for instance, below the melting point of platinum. The light emitted is supposed to be due to some special power of selective emission due to the oxides employed. I have had a good deal to do with incandescent gas mantles and I have no reason to suppose there is any magic effect of this sort going on. The part of the flame where the mantles hang fuses platinum wire easily; and very few materials can stand the temperature without fusing or volatilizing. Lime and many other oxides volatilize slowly from the mantles. I do not mean that the mantles are above the boiling point of lime. I have some idea of its melting point, as I have made a few pounds of melted lime, and run it out on the floor to look at it. The Welsbach mantles, which are now chiefly thoria, are at a temperature near their softening point, and in the making are raised to a temperature at which they begin to soften.

Nernst takes highly refractory oxides as his material. It does not

seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot. Herr Nernst, therefore, heats the rods to make them conduct, and then heats them electrically; preserving a temperature which is within the limits that the material can bear without softening. This means that he can take the most refractory bodies supplied by the whole range of chemical research, and can heat them to a temperature short of their softening point, and thus get an efficiency unknown to workers on the incandescent lamp. Such efficiency also means whiteness of light, so long as the efficiency is not too high. Thus the crater of the arc being at a temperature of boiling carbon, gives a light unpleasantly blue.

The material is worked up into little white rods. Each rod is mounted on two platinum wires; a little paste made of refractory oxides being applied to the joints. The little rod with its two wires is then mounted in a holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause, by a series resistance. The Nernst rod has, therefore, a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance, is 1.5 watts per candle for large lamps, and 1.6 for small lights or low pressures. In small or low-pressure lamps, the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it up with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but very economical in running. The life of rods, running at an efficiency of ½ of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much the first few years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a lifetime. When the rod is worn out, a new rod, with its wire mounts, is all that is replaced. The whole lamp is not thrown away at all. The method of lighting I have described, though it may be used in many cases (such as large public rooms), is really a savage mode of ignition, fit only for dealing with uncivilized commodities, such as gas and tobacco.

The small lamps, and the lamps of medium size, are in practice started by a heating resistance. This is arranged close to the rod, and is shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electromagnet lifts the little hood clear off the rod. In all these forms, the rod and its mountings are replaceable without interfering with the rest of the lamp.

We now have to consider the part the Nernst lamp is probably going to play in the near future. Compared with the small incandescent lamps, as you deal with a material of much higher specific resistance, it is easy to give both small lights and high pressures. The question of lighting is exceedingly important, though it appears trifling at first sight. People are so accustomed to lamps being turned on from the door without any further trouble, that they will generally object to having to light them with matches or spirit lamps; but there are many cases in which it will be quite satisfactory to have one lamp with an automatic lighter to show you the way into the room, the rest being lighted with matches or a spirit lamp as needed. There will be, however, a considerable opening for the cheap, small power, high efficiency lamp; and the disadvantages as to lighting is small in such cases as café, restaurants, churches, hotels, railway stations, and, in short, in most public rooms.

Coming now to the next size—that is to say, lamps of 20 to 200-candle power, and even small lamps in which it is worth while to have automatic ignition—the first cost of such lamps will be higher than the first cost of incandescents; but as the rod itself has alone to be replaced, that is a matter of very slight importance. This size of Nernst lamp has further every chance of completely ousting the carbon incandescent on the score of cheapness, as to renewals, higher efficiency, better colored light, and perhaps more especially high pressures. Once the Nernst lamp becomes so general that systems of distribution are laid out to suit it, instead of to suit the carbon lamp, the carbon lamp is practically "out of the running." It must be remembered that the Nernst can compete with the carbon filament at any pressure that suits the filament; but the Nernst lamp can easily go right out of the depth of the filament, and have the higher pressures to itself. It must also be borne in mind that at present the cost of cables in a system of distribution is an exceedingly large item.

Turning now to the large lamps, they compete with the arc lamp in efficiency. Of course, the efficiency of the arc lamp is not a very definite quantity. The candle power is generally determined by multiplying the current by two, and adding zeros at discretion. All I can say is, that however many zeros the good nature of the maker may supply, a Nernst lamp taking the same power gives a better light. When carefully arranged on the photometer, the arc may be better in given directions; but a lot of light in directions that you do not want, is not the same as the same light distributed with a uniform spherical emission. The arc lamps shown here will give a good idea of the relative values. The Nernst lamp gives a pleasanter, and of course, a perfectly steady light.

Coming to costs, the Nernst will be very much cheaper in first cost, but enormously cheaper in maintenance. It also goes quite away from the arc as to pressures. There is no trouble, for instance, in making large lamps work in parallel at 500 volts, and by using double rods at 1,000 volts. This puts an entirely new development of electric lighting in the engineer's hands.

There is one point I have said little about yet. The incandescent lamp which is still with us gives trouble, not only because of the low pressure it needs, but also because it demands that the pressure shall be kept uniform. It seems quite possible that the Nernst lamp may be made to stand a much greater variation of pressure than the filament. If this proves true, it means an enormous difference in the designing of distribution mains. I do not like to say much about this yet, as the invention is too young, and too little time has been available to make much certain progress in that direction. Results are promising; but it is best not to be sanguine.

It is difficult to discuss an invention like this without being carried away by enthusiasm. I feel, however, that I have but feebly shown forth the probable future of what seems to me the greatest invention in electric lighting that we have seen for many years. Still, I am sure I have not been too sanguine.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, April 10, 1899.

The London County Council and the Quality of the Gas.—New Regulations of the Welsbach Company.

At a recent meeting of the London County Council an important report[1] presented by the Public Control Committee was adopted. The Committee have been considering what means should be taken to secure an improvement of the system at present prescribed by the Gas Companies' Acts of Parliament for the testing of gas in the County of London. They point out that the gas supplied by the Commercial Gas Company is produced at three different stations, and examined at two testing places. The Gas Light and Coke Company, who make by far the largest output, averaging some 60 million cubic feet of gas daily, manufacture at eleven carbonizing stations and are subject to tests taken at fifteen different testing stations. And the South Metropolitan Gas Company have six manufacturing stations and an equal number of testing houses. So there are in all 27 testing stations evenly dispersed over the Metropolitan area, under the control of a body called the Gas Referees, who also arrange the duties of the large staff of examiners. The gas is tested daily at each station for photometrical value and purity. The cost of this establishment is some £10,000 per annum, and is equally divided between the Council and the Gas Companies. This really means between the gas consumers and the ratepayers, and as the consumer and the ratepayer are in many instances one and the same individual, it may be regarded as a public tax. The gas as thus tested is taken from principal streets or centers of consumption and fairly represents the truth. When the question of testing gas first arose, the practice was to test it at the works. Then in the interests of the consumers it was decided that the testing station should be ¼ mile at least from the works, and directly connected to a large trunk main so as to get a fair average sample. All this is plain and definite. Both parties know what they are dealing with, and so far the system has worked satisfactorily. The gas is usually found to be a candle or two above the prescribed rate, and no public complaint has been made on behalf of the consumers. The Gas Companies are giving full meas-

1 See JOURNAL, *ante*, p. 569.

ure and running over, and no one is suffering any grievance or hardship.

But the London County Council have been supplementing the legal tests by experiments with a portable photometer, for some years past, and have found that the testings conducted with this instrument in certain parts of their district give results that do not agree with those arrived at by their own inspectors at the testing stations. Needless to say that the results are low, in some cases 2 or 3 candles less than the official tests, and if the portable photometer was a legal instrument, the Council would have the satisfaction of proceeding against the Companies and fining them. But the portable photometer is not a legal instrument and cannot be made one at the order of the County Council, who choose to ignore the fact that they are asking Parliament to break faith with the Gas Companies. Their action is simply an attack on the gas interests. They have harassed and annoyed the water companies in several ways with no tangible result, and are now turning upon the Gas Companies by seeking to impose a new system of testing that gives results 20 per cent. lower than that at present in use.

That such marked divergencies should exist and be put forward without explanation in an official document is not likely to increase the public confidence in their gas examiners, and before action is taken some further explanation of the position they take up is due both to the Gas Companies and to the Referees. As the latter body was appointed to superintend the gas testing arrangements, they are entitled to have something to say in the matter, and are the proper authorities to explain where the discrepancy comes in. It is always safe to kick at the Gas Companies, and the general impression will be that these bodies have been defrauding the public in some way, by not giving the value indicated by the official tests. In fact, the report, by talking about the need for more stringent measures, leaves the man in the street to draw the inference that the present arrangements fail to secure for the consumer the quality that he is entitled to receive. Others may have something to say about the expense of the existing system, and think that if a £10,000 a year establishment is faulty and defective, they would like to know the probable cost of a thoroughly effective and efficient system.

But the portable photometer condemns itself by the wide range covered by its results, which extend from a maximum of over 16 candles (how much over is not stated) to a minimum of less than 12. This is the extreme variation, but the majority of the tests cover a range of more than 3 candles or something over 20 per cent. It is simply ridiculous to pretend that the bulk of the supply covers anything like such a wide variation, or that such a state of affairs could obtain for a week without causing serious trouble and complaint. Gas engines, regenerator burners and other appliances in regular use call for a practically constant quality, and it is impossible to send out variations of even 10 per cent. without the same becoming a matter of public knowledge. Gas engineers, of course, are well aware that the practical difficulties in the way of making various qualities of gas, or of sending a special brand along the street where the testing station is situated, are such as to far outweigh any addition to the profits that might be obtained by such nefarious practices. They also know that 16-candle gas remains practically constant in quality under ordinary conditions of temperature and pressure, and that as a rule the consumer at the end of the district gets as good value as the one near the works. But the general public cannot know this, and to put a report of the nature of the one now under review in their hands, and leave them to draw their own conclusions, is simply to do the gas companies an uncalled for and undeserved injury.

The real explanation of the wide range of results indicated by the portable photometer is explainable by the absence of the proper photometer room and by the selection of stale samples of gas. At a very early stage in the history of photometry it was found that a regular temperature throughout the experiment was necessary to the securing of an accurate result, and the referees have incurred great expense with a view of maintaining an even temperature in their operating rooms. How is it possible to secure this condition in an appliance rigged up in the open street? The testing stations have been carefully located with a view of getting a fair representative sample of the bulk, but the portable photometer system is diametrically opposite. It admits of the gas for the test having been exposed to all sorts of changes of temperature or having remained in a "blind" pipe for several days. If the pipe was not perfectly sound, some of the hydrogen in the gas would diffuse through the pores of the pipe, and air would also find its way in. If the portable photometer could be regarded as likely to give reasonably constant results, part of the objection to it would be removed. Even if the average was 10 or 20 per cent. below that of the present official tests, some arrangements might be made that would admit of its use. But it is simply like a foot measure made of indiarubber, and it is not reasonable to expect to get fair results with it. The cause of accuracy would not be forwarded by ordering analysts to make their tests on milk or water or sewage in the open streets, and great injustice would be inflicted on a tradesman if he was fined under the adulteration acts on the faith of results obtained under such circumstances. But this is exactly how the London County Council are proposing to treat the Gas Companies, for a photometrical determination is an equally delicate operation.

The Welsbach Incandescent Company announce some important changes in their business arrangements, to take effect on June 1st. They are going to close the system of special agents for the sale of their goods. These agents were appointed, one in each town or district, and enjoyed the special privilege of a 30 per cent. discount off the trade list, whilst gas companies could only get 25, and in other cases still smaller discounts were allowed. To some extent the special agents have to thank themselves for this alteration, as the Company remark that the agents themselves are unable or unwilling to push business to the extent they might do. This is putting the case very mildly, for I have never heard of the special agent taking any particular interest in the business beyond exhibiting the show cards and samples on his premises and attending to orders received in the usual way. The examples of any benefit accruing to the Company by the exertions of the special agent are probably few and far between. In many cases the special agent was an ironmonger or plumber with no special knowledge of gasfittings or gas consumption. While the positive gain secured by the appointment of the special agent was of an uncertain or doubtful character, there was no question as to the disadvantages and loss. Other tradesmen in the same line of business did not care to encourage or recommend a system that drew custom to the shop of a rival, and, therefore, advertised its disadvantages with much more energy. If one of their customers applied for a mantle or other fittings the tradesman did not care to acknowledge that he must go to the agent to get it, and was even more unwilling to send his customer to another shop. So the special agent system proved a much better way of advertising the objections and disadvantages than the benefits of that system. The Welsbach people have decided to withdraw restrictions and open their business to the whole trade, which simply means that they have found the system of special agreements to be a failure, and that they will in future do business in the same way as other people. While acknowledging this improvement in the management, one might almost hope for similar advances in other directions, such as punctuality in filling orders, in respect to which the Welsbach Company have been notoriously deficient. But any anticipations of this sort are greatly discounted by the fact that the Company have raised their prices all round. This will prove a great drawback, as the present high price of mantles makes it difficult to undertake maintenance schemes except at a loss; for consumers are not willing to pay heavy charges for maintenance, and unless the fee asked is strictly moderate they will have nothing to do with it. Gas companies and others will also feel uncertain as to the future and hesitate before entering into contracts dating perhaps three years ahead, and which involve the supply of a large number of mantles. The profits made by the Company are so large that this decision was quite unlooked for. It was hoped that any alteration would take the form of a reduction, and, therefore, the announcement is received with much dissatisfaction. The permanent success of the Welsbach system is dependent on the co-operation of the gas companies by means of a maintenance scheme, and the rise of price is not likely to act as an encouragement to enterprise on these lines.

Iron Making in Central India.

Indian Engineering says that the smelting and working of iron according to the native method is carried on in Central India in eleven districts—Saugor, Damoh, Jabalpur, Mandla, Seoni, Narsinghpur, Chanda, Bhandara, Balaghat, Sambulpur and Raipur.

In Saugor there are six iron mines, which are open to all. These mines gave work during the the past year to 1,844 persons. In Damoh the smelting and refining are done by blacksmiths, who purchase the ore at the cost of a rupee for 24 maunds. Such of the metal as is not not used by themselves is retailed to purchasers from the Northwest Provinces, who convert it into cooking and other utensils for domestic use. The smelting process is crude but effective, a kiln made in the ground serving the purpose with the most satisfactory results. While the smelters purchase their coal from the villages, it must be understood that they are exempt from Government dues. The landlord

however, levies a tax of 16 rupees per kiln per annum. This is in lieu of fuel, which the smelters obtain from the Malguzari forest.

At Jabalpur the average number of furnaces at work throughout the working months of the past year was 28. During the working months, from November to May, 21 men on an average are employed at each furnace. These include wood cutters, charcoal burners, ore extractors, furnace attendants, refiners, bellows men and hammer men. A day's work varies from 33 to 50 seers of crude iron, locally known as "tick ole" or bloom," while the total amount turned out in the seven working months is about 275 maunds. The resmelting of this bloom gives pig iron, which is locally known as "chandia." From 275 maunds of bloom, 220 maunds of pig iron can be turned out.

While the actual process employed in the production of pig iron is more or less the same at all the mining centers, it may not be uninteresting to learn that the Mandla District has 51 furnaces, which produced during the year 1897 a total of 9 tons.

The smelting industry of Seoni, during 1897, came to a standstill owing to the plague; while in the district of Narsinghpur, which is by no means rich in ore, comparatively little was done. The mines, in fact, are on too small a scale to encourage the outlay of any capital. Whereas formerly in this district there were 50 furnaces employing 40 smelters, there are now just half that number of furnaces looked after by 16 smelters. This falling off is due in a great measure to famine, as also to the large mortality rate. Add to this the introduction of English made articles, and the reason for the decrease in the iron industry of the Narsinghpur district is explained.

In the district of Chanda, mining operations, on a similar scale to the foregoing, were carried on during 1897 in five separate localities. The ore being quarried in big lumps, was afterwards broken up into pieces of convenient size and stacked in heaps for further use.

The methods adopted in the other mining centers were similar to those carried on in the mines to which reference has already been made; and with certain minor variations in the cost of transporting fuel, and of labor generally, the same may be said of the smelting operations carried out at Bhandara, Balaghat, Sambalpur and Raipur.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Consolidated Gas Company, of Pittsburg, Pa., have placed an order with the Riter-Conley Mfg. Company for the construction of a complete, new purifying apparatus. The building, which is to have a dimension of 72 feet by 152 feet, is to be fireproof throughout The sides are to be of steel frame work, with brick walls between columns, and the floors around the boxes are to be of steel checkered plate. The boxes, eight in number, are to have the dimension of 25 feet by 30 feet, and hydraulic traveling cranes for handling the covers will run on girders at the sides and center of building.

MR. W. S. WHARTON, Superintendent of the Bellingham Bay Gas Company, of New Whatcom, Washington, writing under date of April 15, says:

To the Editors AMERICAN GAS LIGHT JOURNAL: Mr. O. N. Guldlin, President of the Western Gas Construction Company, has been with us for several days, figuring upon a complete new plant. We signed contract with him on the 11th for a 4-foot set of his apparatus, including scrubbers, condensers, Chollar washer and purifiers. The connections are to be 8 inches throughout, and we expect to send out water gas by July 1st. The following advertisement, which was also mailed to the residents, together with personal solicitation, enabled us so far this season to sell a carload of gas stoves.

THE advertisement referred to by Mr. Wharton, which is printed on a letter head of the Bellingham Company, and which bears three illustrations, showing respectively the "old way" of cooking over a coal fire, the "new way" of performing like work on a gas range, and a clear cut of a modern gas range, is as follows:

"We invite you to call at our office and inspect our new line of 1899 gas ranges. They are becoming so generally used that you will find your next door neighbor has one and will gladly show you the convenience as well as economy of a gas stove. You can do any work on a gas range that can be done on a wood range, and in much quicker time. A match starts the fire and you have heat instantly at any hour of the day or night. It is a mistaken idea that gas cannot be used as cheaply as wood, and in order to prove that our assumption is true we are making the following offer:

"For $17.75 spot cash we will give this No. 1316 gas stove, and will furnish free:

5,500	cubic feet of gas,	if stove is bought	before	April	15th,	1899.
5,000	"	"	"	May	1st,	1899.
4,500	"	"	"	"	15th,	1899.
4,000	"	"	"	June	1st,	1899.
3,500	"	"	"	"	15th,	1899.
3,000	"	"	"	July	1st,	1899.

THE official title of the new Company that has taken over the gas and electric properties at Conshohocken, Pa., is the Conshohocken Gas and Electric Light and Power Company. Its officers are: Directors, A. Lowden Snowden, Frank B. Ball, Jos. B. McCall, Horace C. Jones and Henry M. Tracy; President, A. Lowden Snowden; Secretary and Treasurer, Frank B. Ball.

IT is reported that the proprietors of the Lawrence Gas Company, of New Castle, Pa., have purchased a controlling interest in the Heat and Light Company, of Beaver, Pa.

ARTICLES announcing the incorporation of the Petaluma (Cal.) Gas and Electric Company hare been filed by Messrs. G. Burdell, M. A. Burdell, J. B. Burdell, John M. Coleman and John Sweetser. The capital stock is put at $300,000, of which it is said $140,000 is paid in.

THE statement submitted by the Peoples Gas Light and Coke Company, of Chicago, to the City Controller, on account of its earnings for the quarter ended March 31, 1899, shows that the Company owes the city $54,082, on account of the royalty tax of 3½ per cent. on its gross sales. The figures further show that the Company's business is expanding at a wonderful rate—one quarter compared with the other.

MESSRS. L. M. MONROE, B. P. Mead and J. F. Bliss have applied to the Connecticut Legislature for a bill to incorporate the New Canaan Gas Company.

THE proprietors of the Bethlehem (Pa.) Gas Company are considering a proposition for the sale of its properties to Philadelphia capitalists.

THE Massachusetts Legislature has virtually agreed to increase the salary of the Secretary of the Board of Gas and Electric Light Commissioners in the sum of $500 per annum.

MR. H. M. SHROM has resigned the position of Superintendent to the Greenville (Pa.) Gas Company.

AT the annual meeting of the Rochester (N. Y.) Gas and Electric Company the officers chosen were: Directors, J. Lee Judson, William Runkle, Frederick Cook, Walter S. Johnston, George Archer, H. G. Runkle, H. L. Brewster, A. H. Harris, George C. Hollister, Granger A. Hollister, John N. Beckley, George A. Redman and W. L. Cole; President, J. Lee Judson; First Vice-President, William Runkle; Second Vice-President, Frederick Cook; Treasurer, George Archer; Secretary and Assistant Treasurer, W. L. Cole; Attorney, A. H. Harris.

THE main offices of the Connecticut Lighting and Power Company have been removed from Norwalk to Waterbury, and its capital has been increased to $1,000,000.

MR. J. W. ROGERS, of Evanston, Ills., is still endeavoring to secure a franchise for the operation of a gas works at La Grange, Ills. The scheme seems a feasible one, in that the place is large enough.

A CORRESPONDENT forwards the following: "Messrs. James R. Dunbar, Richard J. Monks and James C. Chalmers, the Commissioners appointed to determine the value of the properties of the Westfield (Mass.) Gas Light Company, which properties the town intends to operate on public account, have filed their report. It was unnecessary to hold protracted hearings, for common sense seems to have actuated the parties to the proposed bargain. According to the report the Company is to deliver all of its possessions, save the Orange street property, to the town on or before noon, June 1st, the town to pay therefor the sum of $147,500. The Commissioners further report that all supplies not included or intended to be included in the inventory, shall be delivered to the town at a value to be determined by three disinterested persons. An inventory of the property to be transferred accompanied the report."

THE new rate of $1.90 per 1,000 cubic feet gross, with 20 cents off for prompt payment, at Rutland, Vt., seems to be giving satisfaction in the home of that sturdy believer in the right of individuals to cater to the needs of their fellow-residents—Mr. M. J. Francisco.

WRITING of Rutland brings to mind the fact that General Stewart L. Woodford (ex-Minister to Spain), David A. Boody (ex-Mayor of Brooklyn, N. Y.), John A. Mead, L. H. McIntire, H. F. Field and Q. S. Bachus, under the name of the Rutland Heating Company, have applied to the Rutland Aldermen for the right "to lay pipes and connections for the purpose of supplying gas to the city and the inhabitants thereof." The ex-Minister and the ex-Mayor and their partners assert their willingness to sell gas in Rutland at $1 per 1,000; so it must seem that the gentlemen have money to lose.

THE Milwaukee (Wis.) Gas Light Company, according to the local newspapers, has decided not to construct the 3,000,000 cubic foot gas holder which it proposed to erect this season. The great increase in the price of iron and steel is given as the cause of the Company's determination.

THE Omaha (Neb.) Gas Company has rented office quarters in the Glasgow building, South Omaha, which move is taken to mean that the Company proposes to pipe South Omaha thoroughly this season.

A CORRESPONDENT in Bridgeport, Conn., forwards the following: "At the annual meeting of the Derby (Conn.) Gas Company the officers chosen were: Directors, C. H. Nettleton, W. B. Wooster, D. S. Brinsmade, Wm. E. Downes, Royal M. Bassett, Thomas Wallace, Wm. H. Mathews, H. Hatton Wood and Chas. E. Clark; President, W. B. Wooster; Secretary and Treasurer, Chas. H. Nettleton. It was also determined to put the gross selling rate at $1.40 per 1,000 cubic feet, with a discount of 15 cents per 1,000 on all accounts settled within 15 days from their presentation. In other words, this means a net selling rate of $1.25 per 1,000, which must be admitted is an eminently reasonable one for the Birmingham-Derby-Shelton district."

A CORRESPONDENT in Albany, N. Y., informs us that Mr. Howard A. Brooke, for the past two years Superintendent of the East Albany (N. Y.) Gas Light Company, died at his home in that city the morning of April 20th. Deceased was a native of Brooklyn, N. Y., where he was born, March 19th, 1848. His first experience in the gas business was obtained in the works of the old Brooklyn Gas Light Company, and in 1871 he went to Albany, N. Y., to occupy a responsible position in connection with the Peoples Gas Light Company of that city. Afterwards he had charge of the Glens Falls (N. Y.) Gas Light Company, leaving there to assume the management of the works at Saratoga Springs, N. Y.

MR. LEWIS J. CARDER, the wideawake Secretary and Treasurer of the Jacksonville (Fla.) Citizens Gas Company, so said a visitor to 32 Pine street, going East after a two months' sojourn in Florida, is having much success in the placing of gas stoves. The Company's office is one of the show business rooms in the city, and its well arranged display of Welsbach burners, fancy globes, ranges, heaters, etc., attracts many visitors, not a few of whom are eventually induced to have a try at gas for other than lighting use.

SIMON J. DONOVAN, President of the Winthrop (Mass.) Gas and Electric Company, has petitioned the Selectmen for "permission to lay and maintain gas pipes in the streets and highways of Winthrop," etc. The hearing was set for April 17th, but we have not been advised of the decision reached. There can be no doubt that a gas plant would prove a profitable enterprise in the place named.

A CORRESPONDENT sends the following: "The city of Toronto and the Consumers Gas Company appear to be getting nearer together in respect to the negotiations for the establishment of a gas plant on what is known as the Island. On April 17th Controller Burns and City Engineer Rust had an interview with Mr. W. H. Pearson, Manager of the Consumers Gas Company, when the proposal that the Company supply gas on the Island was thoroughly discussed. Mr. Pearson was asked if the Company would make any suggestion and he said that its proposal was already before the city. That proposal was that the Company should put in a plant and supply gas to Island residents at $1.50 per 1,000 cubic feet, the city to grant a lot and exemption from taxation. Mr. Burns thought that the Company should supply gas on the Island just the same as it did in the city, but this in turn did not coincide with Mr. Pearson's views. The Company, he said, could not make it pay, but he was willing to submit any proposition the city desired to make to the Board of Directors. Mr. Burns suggested that the city grant a lot at a nominal rate and the Company put up a plant. Finally it was decided that the matter should be discussed by the Board of Control, and that the city should lay a definite proposition before the Gas Company. Mr. Burns stated what probably would be done was that the city would grant a lot near the pumping station at a nominal rent, and the Gas Company would erect the plant and supply gas."

MR. E. A. PINKNEY, General Manager of the Equitable Gas and Electric Company of Utica, N. Y., delivered a very interesting lecture on "The Manufacture of Gas and its Use," about a fortnight ago, before the Utica Council of the Brotherhood of St. Andrew. The lecturer, of course, treated his topics in popular vein, and his hearers are no doubt better posted than before as to the manufacture and treatment of the agent that illuminates their homes and business places with efficiency and economy. Manager Pinkney also proved himself an excellent lecturer, in that his good delivery made all the plainer the consecutivity and conciseness of his story.

THE new gasholder for the Luzerne County (Pa.) Gas Company will be completed by September 1st. The Company will also extend its main system.

MR. J. T. SUTTON has disposed of his interest in the Peekskill (N. Y.) Gas Company. The purchasers will build a new works on a site at the foot of the bluff, alongside the east track of the Hudson River Railroad, which site we believe was formerly occupied by the foundries of the Peekskill Stove Works. The Peekskill plant has been owned by the Sutton family for many years.

THE proposed opposition for Nashville, Tenn., or at least one branch of the proposed "oppositions," for there are two of them, declare that the reduction to $1 per 1,000 cubic feet by the old Nashville Company, will not prevent them from building a works. It will, however, make some difference to the "capitalists" who are to put up the necessary funds; for dollar gas in the district named does not afford *any* margin in excess of a fair working profit.

NOW, if Mr. Swepson, at Knoxville, would follow Judge Malone's lead at Nashville, we imagine that the proposed Tennessee Gas and Coke Company would have its hunt for profit in Knoxville diverted into a flight for other parts. It has been suggested by disinterested observers that the Messrs. Hambleton have a very inviting field at home (Baltimore) for the instituting of gas reforms. However, they likely remember that it is only charity that begins at home.

Springfield (Mass.) Opposed to Municipalism.

The Committee on Street Lighting, Springfield, Mass., charged with the task of inquiring as to whether or not it would be profitable for the city to engage in the operation of a municipal electric lighting plant, has handed in his report. The latter is quite against the proposition, as may be judged from the appended excerpts—these facts were given in the report of the Committee on Municipal Control, at the last meeting of the Ohio Gas Light Association, and are reprinted by request:

"We found the answers received from municipal plants very unsatisfactory, and we must say, in some cases inaccurate, as the answers received from one city were very different on the two circulars sent, and we are advised that on four requests for information similar to our own, no two were alike. This arises principally from the way in which the cost is figured, but the result is very unsatisfactory and misleading.

"After closely comparing the tables of the private and the municipal plants we found that the only true way to compare the two was to find out the candle power received for 1 cent, and the attached tables show the result. There are several items that must be considered before deciding the matter on the figures received. One, and a very important one, is the cost of coal; of the cities giving this information, we have found that eleven private plants paid more than 50 per cent. more than the eleven municipal plants. This factor alone would more than make up the difference in cost per candle power. Another important factor is labor, and while we have no official figures from private information, we are advised that that also is much higher. Another item is the fact that only a very few of the municipal plants have made any allowance for depreciation and those that have, allow only from 1 to 5 per cent., which is far below that allowed by most private plants. Only six of the plants allow anything for interest on money invested, while ten do not. It must be remembered in comparing the two tables that only one of the municipal plants was purchased by the city; all the

(*Continued on page* 655.)

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(*Continued from page* 614.)

others are comparatively new plants recently equipped, thus doing away with all repairs and obsolete machinery.

"If Springfield should decide to establish its own electric light plant it would be necessary, under the laws of the State, and under our contract, to purchase of the electric light company its present plant, with its large amount of obsolete machinery, comparatively worthless. This would mean a loss in taxes to the city of over $5,000, as this company was taxed in 1898, $5,408.22. Owing to the large amount of money that the city would have to pay for the purchase of the plant and to the large depreciation on electrical machinery, together with the fact that the city will be in position next spring to make a very favorable contract with the electric light company, your committee is of the opinion that it is not advisable at this time to enter into such an undertaking."

Public Lighting in New York—1762 to 1899.

An interesting resume of this subject in the *Sun* notes that the appropriation for lamps, gas, electric lights, electric lighting and naphtha lamps for the year 1899 in the boroughs of Manhattan and the Bronx is $1,340,236. In Brooklyn it is $876,012. In Queens it is $344,091, and on Staten Island, the borough of Richmond, it is $125,528, a total of $2,685,867. These figures contrast strongly with the expenses of the city for the same purpose in the first year that municipal street lighting was attempted by public authority in New York. This was in 1762. Prior to that time no systematic attempt to illuminate New York territory had been made except the vague regulation that the occupant of every tenth house on any inhabited street should hang out a lantern on a pole between the hours of sunset and sunrise.

In 1762 an Act of Assembly was passed giving the corporation authority to provide means for lighting the city. In 1762 the first posts and lamps were purchased. These were few in number. In 1770 a contract was made with J. Stoutenburg for supplying oil and lighting the city lamps for the sum of $760. In 1774 the city employed 16 lamplighters. This system of lighting the city remained substantially the same until the contract with the New York Gas Light Company, in 1823, by which certain parts of the city were to be lighted by gas. Since then sundry improvements have been made, particularly such as have been possible since the introduction of electric light. An expenditure of $2,500,000 for lighting gas is, no doubt, considerable, but some of the propositions made to reduce it are of a grotesque character, being based on the erroneous idea that such expenditures are for illuminating gas only, whereas the fact is that included in this item are the expenses for lamp posts and fixtures, for pipe connections, glass and street numbers, and moreover the expense for electric light is included, a very considerable share of the whole amount, both in New York and Brooklyn.

The Market for Gas Securities.

Consolidated, and other city gas shares as well, are dull and lower, the break in Consolidated being especially pronounced. During the week it sold up to 203, and opened to-day (Friday) at 198, but at noon trading had been done in it at as low a figure as 193. There does not seem to be any good reason for this sharp decline, although those interested on the short side are making the most they can out of the fact that the contest for business between the local companies is quite bitter just now. This, however, has been known for some time, and it is our opinion that insiders are depressing the shares for the sake of making a final scoop. New Amsterdam common is 36½ to 37¼, Standard common is 130 to 135, and the preferred is 145 to 150.

Brooklyn Union is in good demand, at increasing figures. Bay State hovers between 3½ and 5, and Peoples, of Chicago, shows an inclination to reach the 130 mark. The parties seeking control in the Washington (D. C.) Company have formally offered $60 per share for the stock, which is equivalent to 300 on a par value of 100. Cincinnati gas sold down to 194½, on the application of certain well known capitalists for a franchise to operate an opposition gas works in that city. Peoples, of Jersey City, is offered at 225.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

May 1.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	195	195¾
Central Union, Bonds, 5's	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	300	310
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co.	13,000,000	100	36½	37¼
Preferred	10,000,000	100	65	67
Bonds, 5's	11,000,000	1,000	103¼	104
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000	..	107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	145	150
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	153½	154
" " Bonds (5's)	15 000,000	1,000	118	.
Bay State	50,000,000	50	3½	4
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	.
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	0
Buffalo City Gas Co.	5,500,000	100	12½	13½
" " Bonds, 5's	5,250,000	1,000	93	93½
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	70	75
1st Mortgage	1,207,000	1,000	101	103½
Consumers, Jersey City	2,000,000	100	88	..
" Bonds	600,090	1,000	104	106
Cincinnati G. & C. Co.	8,500,000	100	195½	196
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	66½	67½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	380,000	1,000	80	84
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	95½	96
" Inc. 5's	31,000	100	..	..
quitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	68	70
" Bonds	2,000,000	..	80	82
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	100	105
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	225	275
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	54	54½
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	123	130x
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	127¼	127½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111½	112
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	215	225
Rochester Gas & Elec. Co.	2,150,000	50	52	..
Preferred	2,150,000	50	103	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	74	75
St. Paul Gas Light Co	1,500,000	100	30	32
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	16	19
Bonds	1,612 000	1,000	85	89
Washington, D. C	2,600,000	20	292½	298
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	97	97¾
Bonds, 5's	3,830,500	.	106	108
Wilmington, Del.	550,000		208	..

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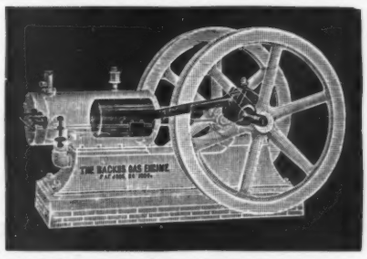

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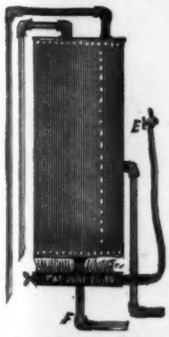

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BUFFALO CITY GAS CO., BUFFALO, N.Y., April 1, 1899.
J. P. B. SADTLER & CO., 813 S. Howard St., Baltimore, Md.
Gentlemen—Replying to your favor of the 30th of March. The Heller Heaters that you have already furnished seem to be large enough, and we will not at present care to use any of the larger size that you mention. We have had no complaint in regard to the Heller Heater that we have used in Buffalo, and so far they are giving us good satisfaction.
Yours very truly, E. H. JENKINS, Engineer.

BALTIMORE, MD., March 24, 1899.
J. P. B. SADTLER & CO., 813 S. Howard St., Baltimore, Md.
Gentlemen—A test of the Heller Water Heater witnessed by me March 21, 1899, showed that with a consumption of 30 feet of gas per hour, the water in a 28-gallon galvanized boiler could be heated from 59° to 102°, or 43° in one hour. Temperature of room at time of test 64°.
Respecfully,
GEO. BEADENKOPP, Ass't Engineer, Con. Gas Co.

Clamp Heater to Pipe about 4 Inches away from bottom of Boiler. Always use an independent connection, or regular Gas Stove connection, so as to get a good flow of Gas.

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Halifax, Eng.	1,000,000
Toronto,	250,000
Ottawa,	250,000
Toronto (Second Contract, Remodeled),	2,000,000
Lindsay (Remodeled),	125,000
Belleville,	250,000
Ottawa (Second Contract),	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled),	250,000
Kingston, Pa.	125,000
Montreal,	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract),	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, Eng. (Second Contract),	300,000
York, Eng.	750,000
Rochester, Eng.	500,000
Kingston, Ont.	300,000
Crystal Palace District, Eng.	2,000,000
Duluth, Minn.	300,000
Caterham, Eng.	150,000

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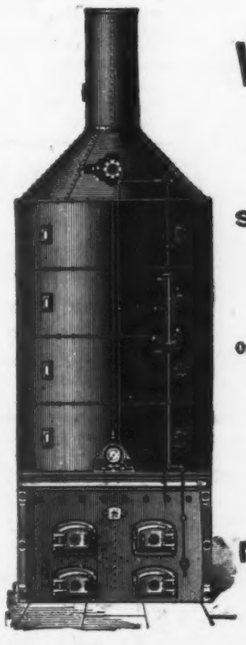

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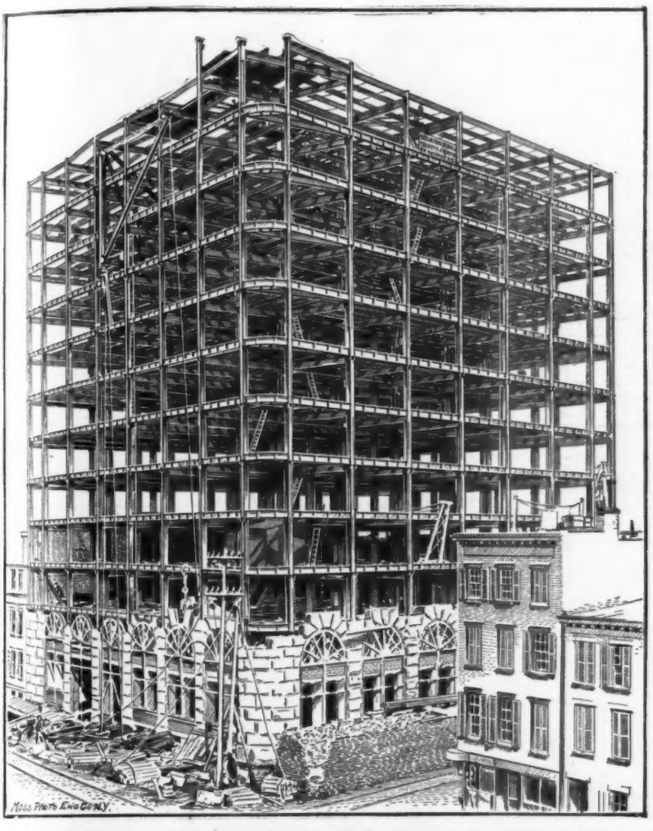

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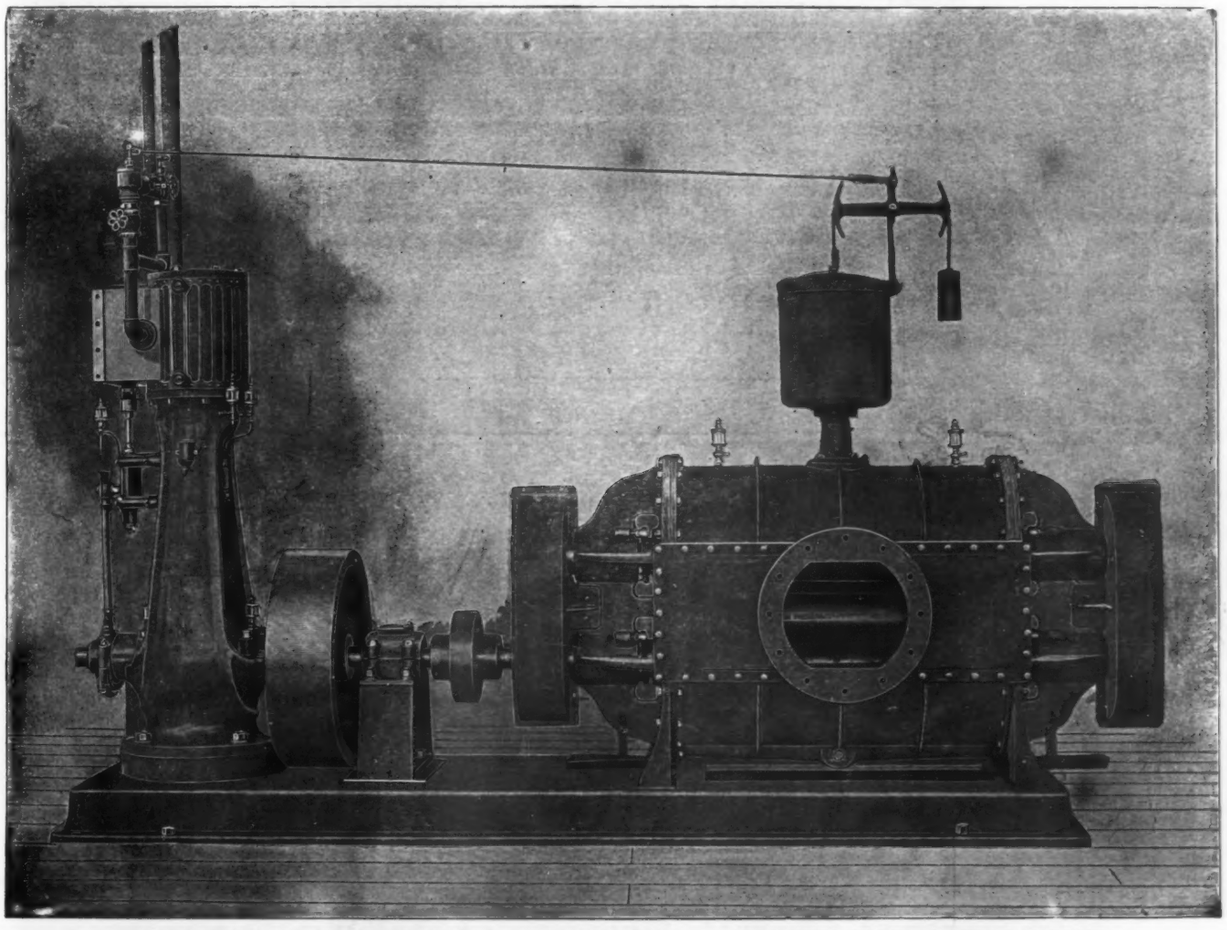

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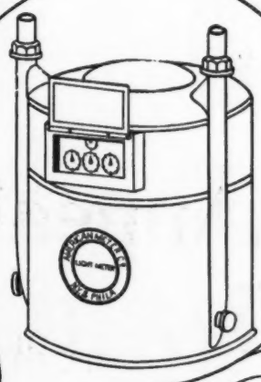
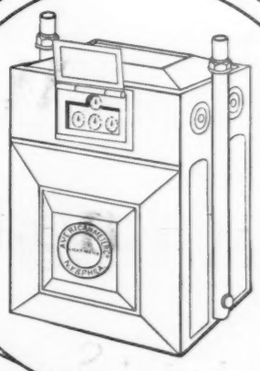
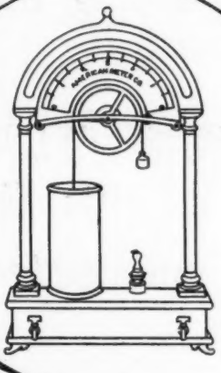
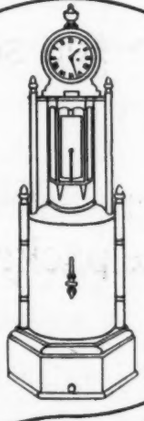
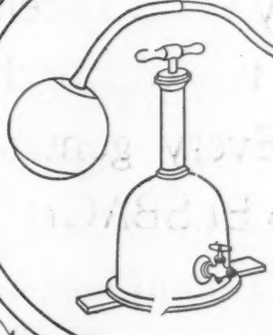






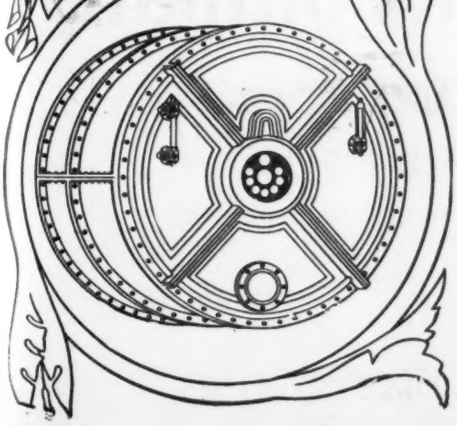


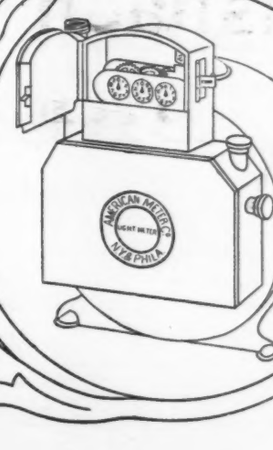


PUBLIC LIGHTING TABLE.

MAY, 1899.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	7.30 PM	1.40 AM	6.45	4.00
Tue.	2	7.30 LQ	2.20	6.45	4.00
Wed.	3	7.30	2.50	6.45	4.00
Thu.	4	7.30	3.20	6.45	4.00
Fri.	5	7.30	3.40	6.45	4.00
Sat.	6	7.30	3.50	6.45	4.00
Sun.	7	7.30	3.50	6.55	3.40
Mon.	8	7.30	3.50	6.55	3.40
Tue.	9	7.30 NM	3.50	6.55	3.40
Wed.	10	7.30	3.50	6.55	3.40
Thu.	11	7.30	3.50	6.55	3.40
Fri.	12	7.30	3.50	6.55	3.40
Sat.	13	7.30	3.50	6.55	3.40
Sun.	14	10.30	3.40	7.00	3.30
Mon.	15	11.00	3.40	7.00	3.30
Tue.	16	11.20	3.40	7.00	3.30
Wed.	17	11.50 FQ	3.40	7.00	3.30
Thu.	18	12.10 AM	3.40	7.00	3.30
Fri.	19	12.40	3.40	7.00	3.30
Sat.	20	1.10	3.40	7.00	3.30
Sun.	21	1.30	3.40	7.10	3.15
Mon.	22	2.10	3.40	7.10	3.15
Tue.	23	No L.	No L.	7.10	3.15
Wed.	24	No L. FM	No L.	7.10	3.15
Thu.	25	No L.	No L.	7.10	3.15
Fri.	26	7.50 PM	10.10 PM	7.10	3.15
Sat.	27	7.50	11.00	7.10	3.15
Sun.	28	7.50	11.40	7.15	3.15
Mon.	29	7.50	12.20 AM	7.15	3.15
Tue.	30	7.50	12.50	7.15	3.15
Wed.	31	7.50 LQ	1.20	7.15	3.15





TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150 30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45

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Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Total	11	9,125,000 "
Previously built	294	187,100,000 "
Grand Total	305	196,225,000 "

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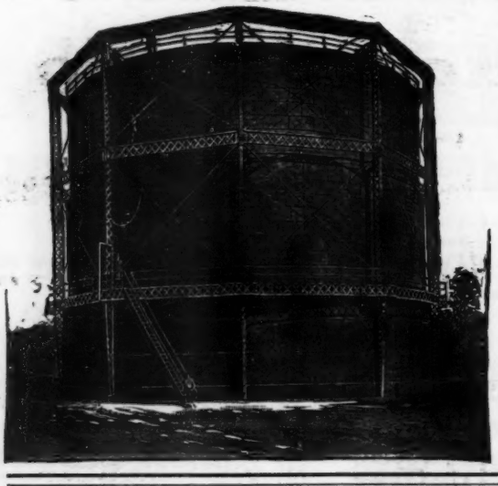

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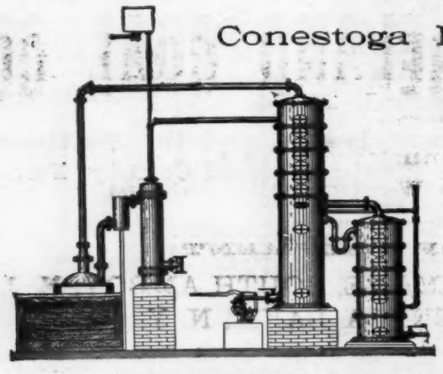

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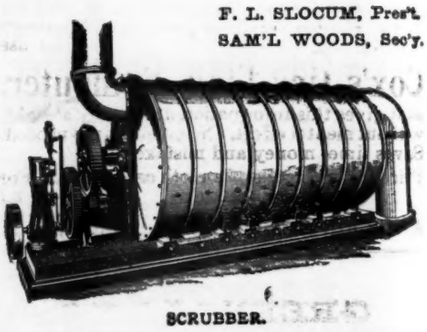

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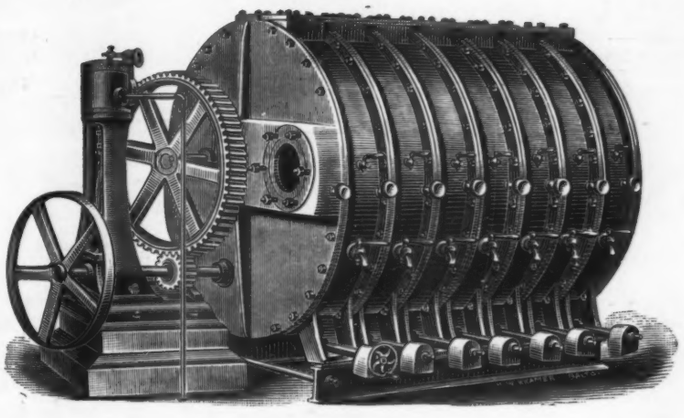

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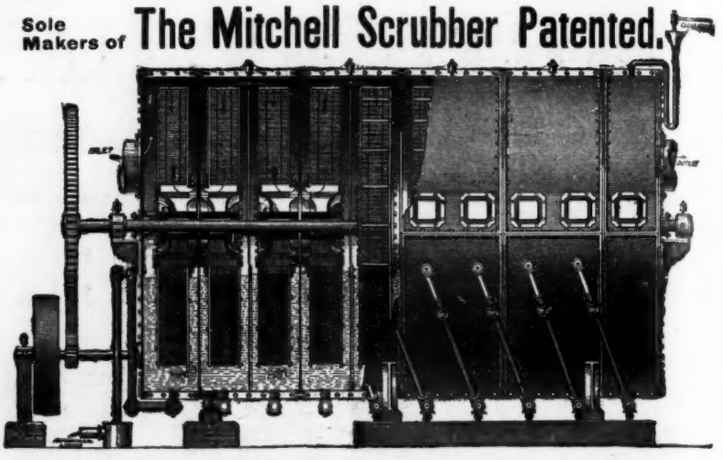

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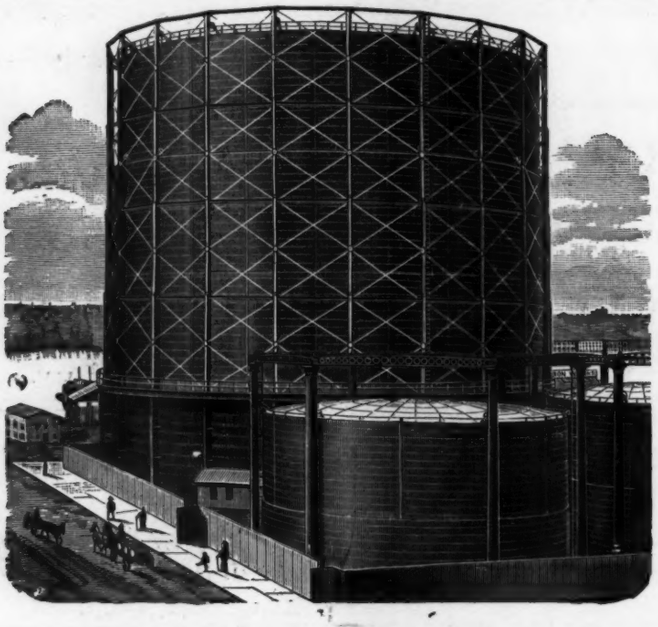

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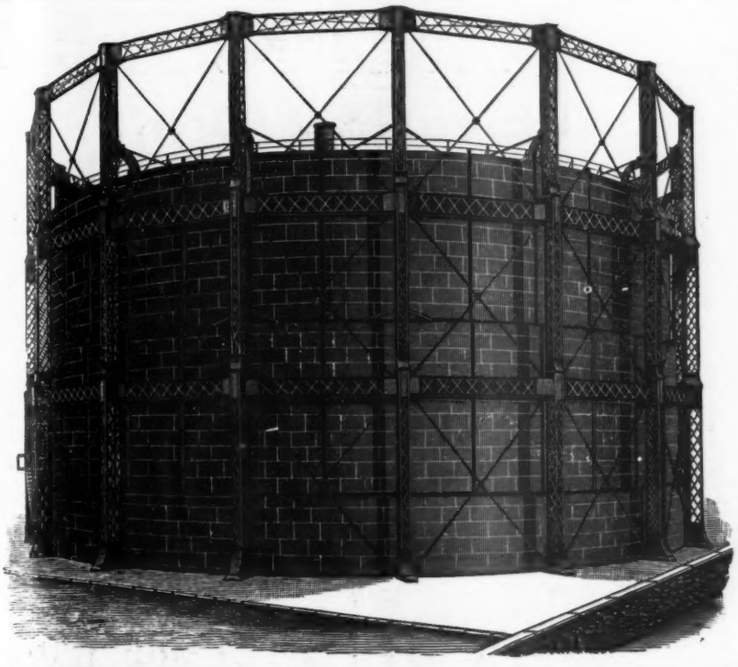

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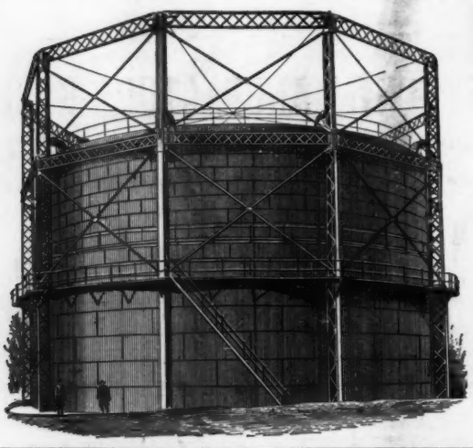

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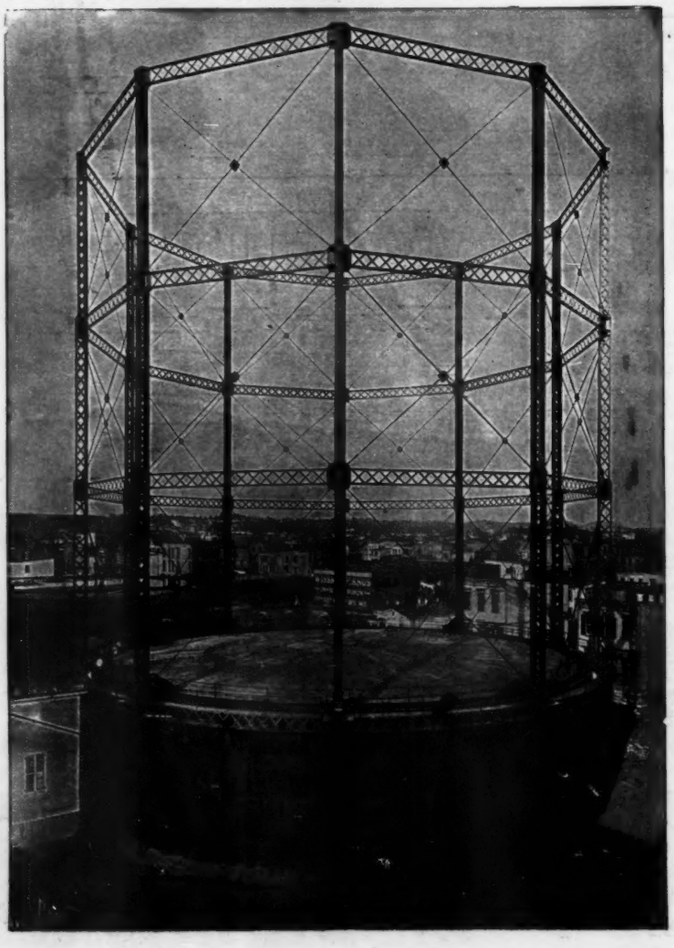

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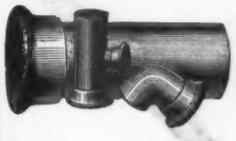

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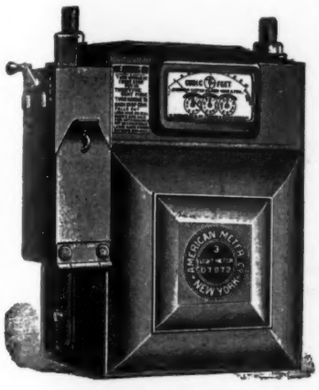

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